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EDITORIAL.

IT again becomes our pleasing duty, in completing the twentieth volume of KNOWLEDGE, to express our gratification at the continued support accorded to us by our readers, and our acknowledgments to the many friends who have contributed to our columns during the year.

The appreciation of our programme for 1897 gives us more confidence in bringing before the notice of our readers the following particulars of some of the more important features of our volume for 1898.

The Rev. Thomas R. R. Stebbing, M.A., F.R.S., will contribute a series of illustrated papers on "The Karkinokosm, or World of Crustacea."

The crustaceans have been much neglected in popular magazines of science, and we feel sure that this series of articles, from the novelty of the subject and from the practical and popular way in which the papers are written, will be of great interest to our readers.

Arrangements have been completed for a series of illustrated Botanical Studies, which will be contributed by Mr. A. Vaughan Jennings, F.L.S., F.G.S. These papers are intended to show that from simple microscopic preparations it is possible (1) to illustrate the modes of reproduction in each of the great groups of plants; (2) to bring out the relationship between the higher cryptogams and the flowering plants; and (3) to demonstrate that it is only by detailed microscopic work that we are able to discover this relationship.

Mr. Frederick Enock, F.E.S., F.L.S., will continue, in the new year, the narrative of his researches into the life histories of minute insects, which, in conjunction with his excellent photographs, have already given such lively satisfaction to our readers.

Prof. Grenville A. J. Cole, M.R.I.A., F.G.S., will commence, in the February Number of KNOWLEDGE, a series of articles, illustrated by the camera, on the Geological Features of Ireland.

Contributions have been promised also by Sir William Gowers, F.R.S.; Mr. W. Botting Hemsley, F.R.S.; Mr. R. Lydekker, B.A., F.R.S.; Dr. J. G. McPherson, F.R.S.E.; Mr. C. F. Townsend, F.C.S.; Mr. H. Snowden Ward; Mr. C. A. Witchell, and many others.

Mr. E. Walter Maunder, F.R.A.S., is going out to India for the purpose of observing the solar eclipse in January, and will describe his experiences in our columns. Dr. Isaac Roberts, F.R.S., to whom we are so much indebted for his delightful photographs, has very kindly promised to furnish some further plates. Mr. W. F. Denning, F.R.A.S., the well-known meteor observer and discoverer of comets, has arranged to supply a short article each month, giving matters of contemporary interest. Mr. Herbert Sadler, F.R.A.S., will continue his useful column on the Face of the Sky. Contributions to the Astronomical Pages have also been promised by Mr. C. Easton, F.R.A.S., Mr. A. Fowler, F.R.A.S., Mr. J. E. Gore, F.R.A.S., Mr. William Shackleton, F.R.A.S., and others.

The British Ornithological Notes, which now have the support of a large number of eminent ornithologists, will be continued on the same lines as hitherto.

XUM

THE HEART OF A CONTINENT.

By Grenville A. J. Cole, M.R.I.A., F.G.S., *Professor of Geology in the Royal College of Science for Ireland.*

In a previous article* we have seen how unstable the edge of a continent appears to be, and how the line along which the sea meets the land is usually one of movement in the earth's crust. By upthrust along lines of fracture, or by the growth of mountain-folds, the land becomes raised above the sea; or, on the other hand, the oceanic basins deepen, the water retreats from the surrounding shores, and the continents grow by remaining inactive and at rest.

Prof. Suess,† indeed, regards the formation of ocean-basins as the true cause of continental land; the subsidences on the surface of a primæval globe first collected and localised the water, and so rendered the earth fit for our present air-breathing fauna.

It would seem, then, that we might seek for peace in the heart of a continent, far from those lines of weakness that have determined its existence and its form. But here again the lover of repose is soon doomed to disappointment.

In the first place, the heart of a continent gives us a more terrible picture of the forces of denudation than is obtainable by a visit to any ordinary coast. Along the cliffs, say, of Dover, of Trotternish, or of Moher, occasional storms may bring down tons of rock, which are reduced to fragments, and are distributed along the shore by the constant swirling of the waves. The evidence of the catastrophe is thus in time removed; the face of the land still looks out proudly on the sea; and the new rock-surfaces and the upright walls give an air of freshness to a sea-board stricken with decay. Even when we consider the ordinary sandbanks as products of the destruction of the land, so much of their mass is hidden from us beneath the water that we gain no adequate conception of the transference of material that is going on.

But in the heart of a continent it is a very different matter. The products of the decay of the innermost masses stream only very slowly towards the shores. Enclosed or rainless areas exist, whence no escape is possible, except for particles of fine dust, which may be carried outward by the winds. The tendency is, then, for the huge refuse-heaps of nature to remain *en évidence*, and for the varied slopes of crag and brae to become buried in their own detritus.

In high altitudes, the processes of denudation are always imposing, and at times truly catastrophic. Even in our own islands, where the ridges and plateaux have long been worn down below the heroic scale, we frequently see the relics of larger action; the glacial moraines and huge fallen masses, among which we may walk unconcernedly to-day, point to a time when the warfare of the atmosphere against the earth was carried on under far more effective conditions.

At the foot of every mountain-peak, however self-assertive it may be, cones of débris may be seen, their apices lying in some groove or "stone-shoot" of the rock above. From this they spread outward, in fan-like forms, until they coalesce at their outer edges, and form taluses that conceal the whole lower slope of the mountain. Gradually, the growth of these taluses alters the stern aspect of the landscape. Their summits creep back, higher and higher, up the surface of the mountain-wall; their lower portions encroach on the valleys, and assume a characteristic and slightly concave curve. In times of frost, or whenever a storm is raging round the crests above us, we may hear the stones bounding down the grooves that guide them, we may see them leaping freely out on to the talus, and we may note the disturbance that the larger blocks produce, as they help the whole mass to settle down in curves of greater stability and rest.

Even under the Drei Zinnen, the most striking of the Dolomite towers in Tyrol, this contrast of sheer crag and sloping talus is at once perceptible; and the taluses are clearly destined to be in time the predominant feature of the country. The peak of the Matterhorn, again, has sweeping skirts, as it were, formed by stones that have fallen from its crest; and many lesser summits are threatened with burial under the products of their own decay.

A fine example of the banking-up of taluses against a whole mountain-wall occurs under the Schwarzhorn, at the summit of the Flüela Pass in Switzerland (Fig. 1). Numerous cases will occur to the minds of travellers in our own islands, such as the huge "screes" of the North Country, the slope of Craig-y-llam, on which the road is carried at the back of Cader Idris, or the long curving sides of Glen Docharty, descending on Loch Maree in Ross-shire. The crags of Wastwater and the Pass of Brander show earlier stages in the growth of talus-cones.

Day by day, year by year, these cones slip outwards, stones and sand and mud being carried away from their lower edges, while they are added to above by the constant denudation of the peaks. Frequently, a few heavy showers alter the angle of repose, and dangerous landslides occur, by which the face of the landscape becomes transformed in a few brief hours. The oozy mass, a thick river of mud and stones, fills up the picturesque ravines, obliterates the details of the valley-floor, and settles across it as a level stretch of alluvium, which the streams may now be powerless to clear away. Everywhere in the heart of our continent there is this tendency to the abolition of variety and detail—to the production of a uniform alluvium (Fig. 2). In time, just as the cones on a mountain-side coalesce to form a continuous talus, so the flatter fans of detritus, emerging from the main valleys themselves, will unite in the lowlands, and will yield us the monotony of a plain. In fact, as I have elsewhere stated,* "the whole plain results from the uniting and overlapping of exceedingly flat cones of detritus, which become less clearly bounded—more unstable at their edges—as they leave the limits of the hills." In this way we have the great plain of Northern Italy, "formed by cone uniting with cone, delta with delta, all spreading outward into the continental valley of the Adriatic."

It is probable that in some parts of Russia and Siberia this essentially inland and continental feature can be studied to the best advantage. Prof. Pavlow† has recently described the general characters of the deposits along the basin of the Volga. The beds of "diluvium" cover the slopes of the hills, and correspond in composition with the rocks that form the neighbouring heights. They are inclined at a very gentle angle to the plain, and "are merely the products of disintegration of the older rocks, products heaped up on the slopes, worked over again and again by the action of the rains, and rendered more and more fine-grained in proportion as they are carried farther from their place of origin. These deposits, resting on the more abrupt slopes of the high-

* Knowledge, Vol. XX. (1897), p. 208.

† "Das Antlitz der Erde," Bd. I., p. 778.

* "Open-Air Studies," p. 127.

† "Guide des Excursions du VII. Congrès Géologique International," 1897, Section XX., p. 11; and Plates A (Fig. 1) and D (Fig. 2).

lands, have softened the former contours of the country; at present they are rapidly becoming eroded, producing locally a series of ravines."

Away across the great Siberian steppes, and into the heart of China,* where the continental uniformity has impressed itself on the character of a people, the decay of the older structural features is levelling up the country, and is producing, here a cultivated plain, here a mere desert of shifting sand-dunes. Whether the winds or the rivers are engaged in distributing the material, the result is inevitably the same. The heart of our continent is becoming shorn of all its salient features, and the form of its surface is approximating towards that of the primæval earth.

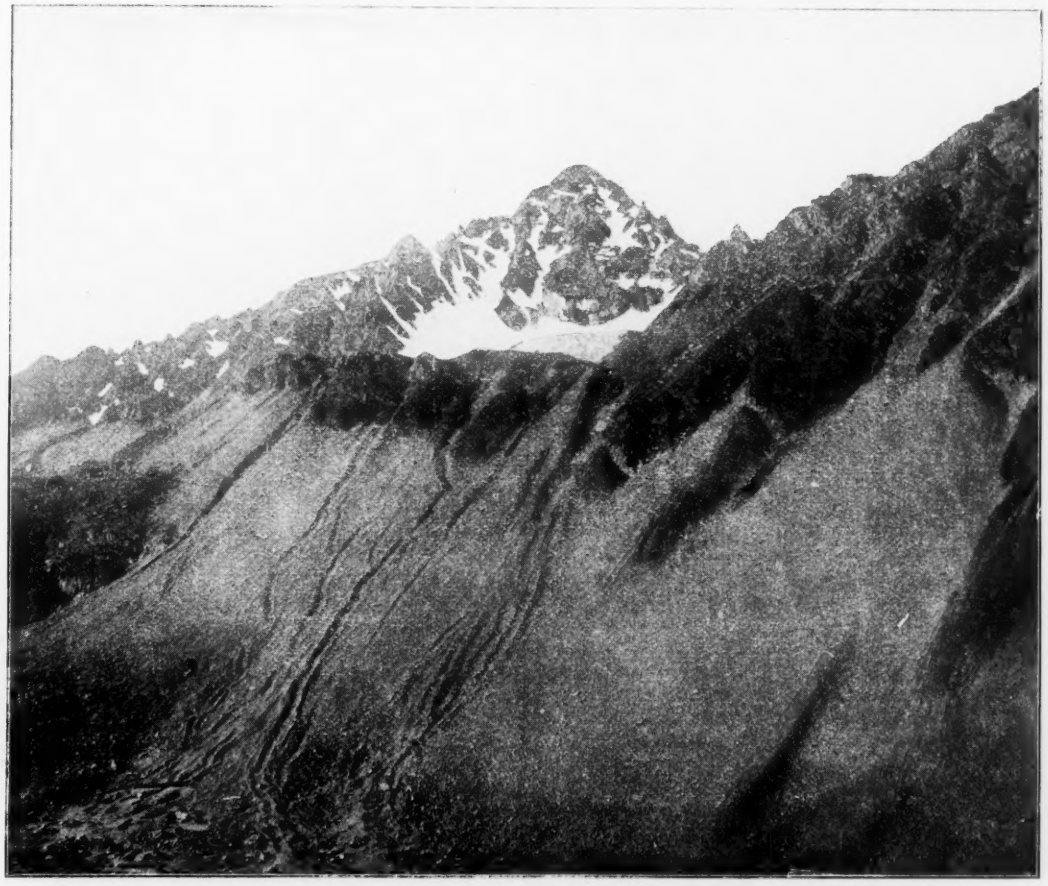


Fig. 1.—Slope of the Schwarzhorn, summit of the Flüela Pass, Switzerland, showing burial of original features in cones of detritus. (From a photograph by Sigrist-Herder, Davos-Platz.)

The burial of normal landscapes under the action of the wind is well exemplified in the Sahara. Prof. Walther believes that granites have contributed the sands of this great desert, while Zittel points to the sandstones of Devonian age that fringe the area on the south.† In any case, the present dry conditions were probably preceded by far wetter ones, under which huge fans of alluvium were formed, providing a series of loose sandstones of comparatively recent age.* These are now laid hold of by the wind, and furnish material for the sand-blast that attacks all the projecting masses in the country. The bluffs of older rock that still survive are being eaten into and deeply scored by the denuding wind; while the great range between the temperature of day and night assists in the destruction of their surfaces, by alternate expansions and contractions. The result is that the desert is filling up, and is overflowing into Egypt at its eastern end. The deposits consist in this case, as M. Rolland says, of "aërial alluvium, the formation of which is contemporaneous and is going on beneath our eyes."†

We can here only refer to the "Löss" of Central Europe, covering much of the country from the Rhine to the East of Russia—a fine clayey deposit, brought down by flooded streams and spread out uniformly by the wind; to the enormous stretches of modern river-gravel in the valley of the Garonne or of the Rhône; and to the Alpine débris poured out into Bavaria (Fig. 3), or into Italy, from Turin to the Adriatic. In every continent, from the basin of Australia to the plateaux of the United States, from the feet of the Central Asian ranges to the löss-filled

* See Von Richthofen, "China," Bd. I., p. 56, etc.

† See Sokolów, "Die Dünen," 1894, p. 195.

* G. Rolland, "Sur les grandes Dunes de sable du Sahara," *Bull. Soc. géol. de France*, Ser. 3, Tome X. (1881-2), p. 38.

† *Op. cit.*, p. 35.

plains of Argentina, the same effacement of surface-features may be seen—the continents disappear, as it were, beneath the encroachment of a flood. Can we believe, then, that the heart of a continent is more stable than its coastline? Without upward movements, without the formation of new folds in the earth's crust, continental land must be reduced to stretches of desert, above which no highland will remain to cause condensation of the air

Fig. 2.—Toblach and the Valley of the Rienz, in Tyrol, showing the formation of a plain by deposition of detritus at the foot of mountains.

blown inward from the ocean; or to desolate regions of salt marshes, the evaporating relics of former inland lakes; while here and there a line of mounds, coated with conglomerates decaying into sands, will mark the site of our more famous mountain-chains.

How soon such a result might be arrived at is a matter of speculation rather than of accurate inquiry. We are still in the position of old John Playfair,* who wrote in 1802, "It has been supposed that the Pyrenees diminish about ten inches in a century; but what confidence is to be put in this estimate I am unable to determine." It is certain, however, that the decay is rapid compared with what we know of geological time. The converse of this statement is that the continents must themselves be young.

Examination of the geological maps that have been drawn up by various Surveys will show us that any large surface of the earth, where not buried in recent detritus, is of a very complex character. In the heart of a continent, as on its margins, we find expressed the sum of a series of earth-movements which have been going on since the first consolidation of the crust. Evidences of elevation alternate with those of depression; and even such oceanic deposits as much of the Upper Chalk† and the Nummulitic Limestone are found stretching across continental plateaux, or infolded in the crests of mountains.‡ It is certain that the prominent features of our continents, the sources of our most extensive alluvial deposits, are of comparatively recent geological age. Here and there, we have broad masses, like Scandinavia and Scotland, that seem to have been elevated, high and dry, for an abnormal length of time; and here and there, in the interior of our continents, knobs and bosses of the ancient floor stand up above the Secondary and Tertiary deposits. But the lowlands in which the gravels and the dust accumulate have often emerged only recently from beneath the sea. Deltas have been converted into a foundation for talus-fans, and marine strata, barely consolidated, have become a prey to the distributing action of the wind. Thus the geological map of Russia* shows the large area occupied respectively by the marine beds of the Caspian area, stretching northward, and those representing a recent Arctic inflow, stretching southward. These beds are barely older than the dawn of human history; yet they indicate that the Danube and the Black Sea then drained out northward, into an arm of the Polar ocean. The sea, in fact, then covered a large midland area of the joint Eurasian continent. The lowlands of the Amazon,† moreover, in the very centre of South America, are occupied by some of the most recent marine deposits of the continent—older than those of the Caspian steppe, but still of "Later Tertiary" age; and these deposits are now one thousand five hundred miles inland from the Atlantic Ocean.

Prof. Suess, at the end of the first volume of his "Antlitz der Erde," has summarised his investigations into the characters of the existing continents; and we may rapidly come to the conclusion that there are no special buttresses supporting our great land-masses, but that fracture of the crust may let in the ocean over half a continent at a time. Thus the tablelands of South and Central Africa appear to date from the Carboniferous period; but they are grouped with Madagascar, India, and the desert-lands of North Africa and Arabia, to form one of the great structural divisions of the earth. The Indian Ocean entered this continental area in comparatively recent times; and Dr. Gregory ‡ insists that great changes in the relative levels of the areas examined by him in British East Africa have occurred during the Later Tertiary periods. He confirms Prof. Suess's opinion that the "Great Rift Valley," from the Zambesi to the Jordan, is an elongated region of recent subsidence.

Fig. 3.—Landscape in the plain of the Danube, near Straubing, Bavaria, showing the character of a great area of alluvial accumulation. (From a photograph by Mr. A. W. Bawtree, F.L.S.)

Suess divides "Eurasia" from the broken and faulted continent of "Indo-Africa" by the zone of intense folding that dates mainly from Upper Miocene times. From

* "Illustrations of the Huttonian Theory," p. 380.

† See W. F. Hume, "The Genesis of the Chalk," *Proc. Geol. Assoc.*, Vol. XIII., p. 241.

‡ Compare "The Student's Lyell," ed. by J. W. Judd, p. 230.

* "Carte géol. de la Russie d'Europe, éditée par le Comité géologique," 1892.

† C. B. Brown, "On the Tertiary Deposits of the Solimões and Javary Rivers," *Quart. Journ. Geol. Soc.*, Vol. XXXV., pp. 81 and 82.

‡ "The Great Rift Valley," 1896.

the north-west of Africa, through the Alps and their offshoots, through Cyprus, the foot of the Himálayas, and down to the isles on the west of Sumatra, the contorted border of this modern continent can be continuously traced. We have already seen how marine invasions from the north occurred across Eurasia in the Post-Pliocene period, in which we actually live. In North America we have a solid mass of highlands, which thrust off the brackish waters of the Laramie Beds at the very opening of the Tertiary era. But there is no great stability in a mass that is bounded on the west by the active zone of the Pacific;* and it is well known that even in the plateaux of Utah, five hundred miles from the coast, there are faults of such recent character that we may assume that powerful movements, of continental magnitude, are still being carried on.†

The conviction of students of the Himálayan border, that the great ranges of Central Asia have not yet come to rest, has been strengthened by recent observations; and the upward and outward movement of the rim of Suess's Eurasia may result in remarkable changes in the Mediterranean and the Indian Ocean. A curious tongue has already shot forth from the new continent, and has formed what we know as Italy and Sicily, which date only from Pliocene and Post-Pliocene times. Not only do bands of marine Lower Pliocene strata lie upon both flanks of the Apennines from Turin to Calabria, but in Sicily the highest beds, abounding in living species of mollusca, are found already elevated three thousand feet above the sea.

In the heart of our continents, then, mountains have doubtless yet to rise, while new areas of subsidence, ringed about by faults, have yet to be provided to receive the products of their decay. Only in exceptional cases can we watch these epic movements as they proceed. Usually denudation is all the time at work, smoothing down the surface, and preventing the formation of scarps along the lines of faulting. As Suess‡ remarks, "In Bohemia, in the Palatinate, in Belgium, in Pennsylvania, the plough often drives its furrows calmly across the most powerful dislocations." Whatever the floor of our continents may be, it gives way frequently beneath us. A wave passes through the crust, which has been racked and strained ever since it first cooled upon the globe. Our geographical boundaries first fluctuate, and are then obliterated. The great trough and arch form themselves, and remain stationary for what we call a geological period. And so, with a delusive aspect of stability, on the one hand a new ocean, on the other a continent, is born.

MODERN ALCHEMY.

By W. E. ORD, B.A.

A LOVE of science for its own sake has been the noblest incentive of the world's greatest discoverers, but in the pursuit of chemical science there has ever been an inducement of a more practical kind. We find the alchemists of old continually urged forward in their arduous labours by the dreams of wealth which their science, if it could be so called, appeared to render capable of realization; or perhaps by the infinite possibilities which seemed to exist in the changing substances around them. In mediæval times, when the European world was throbbing with the excitement occasioned by the discovery of untold wealth in the New World, when adventurers were giving their lives in the vain endeavour to become rich at a stroke, the alchemists in their laboratories were scarcely less eager in their investigations, impelled by that dream of wealth which never fails to rouse the dormant energies of mankind. Strange as the hope of the alchemists may seem to us, the idea of transmuting the baser metals into gold appeared, with the knowledge of chemistry then possessed, to have a plausible foundation of fact. In the view of the alchemists, the baser metals could have none of that stability of character with which the pure elements are now associated. Examined in an impure state, they were changeable in their properties, and often unrecognizable, for a minute trace of impurity alters their character. A trace of lead or arsenic, for example, renders gold exceedingly brittle and alters its colour; while, as is well known, a small quantity of carbon in iron causes it to become elastic, and if more be present it becomes hard and brittle. In addition to this instability of character, the transmutation had every appearance of possibility under the view then generally accepted—and first taught by Geber, an Arabian chemist—that all the metals were alloys of sulphur and mercury in varying proportions, their various properties being produced by the existence of a greater or less quantity of either of these elements. The noble metals were held to be particularly rich in mercury and poor in sulphur, and the transmutation of the baser metals was thought to consist in the withdrawal of sulphur from them and the addition of mercury. The difficulties and confusion which the alchemists had to contend with were still further increased by the spirit of mysticism pervading their writings, and the consequent impossibility of following up the discoveries of previous investigators. In view of such difficulties, it is not surprising that, though a belief in alchemy lingered on into last century, the alchemists should have been a long way from finding the true path to a process of transmutation which is still regarded by many as undiscoverable.

Within the past year a claim has been made to the discovery of a solution of the problem of the alchemists which is both startling and interesting. Dr. Emmens, an eminent chemist of New York City, and inventor of the high explosive "Emmensite," has recently published an account of some researches which would seem to have resulted in the actual transmutation of silver into gold, an achievement as important in its economic aspect as it is revolutionary with regard to chemical theory. In order, however, to properly appreciate the work which appears to have been accomplished, it is well first to consider the subject in the light of modern chemistry. The chemist, in pursuing his analyses of matter as far as his methods will permit, discovers that there are some seventy kinds of substances which refuse to be split up into other substances, and to these ultimate constituents of matter he gives the name of "elements." To the elementary bodies he finds, by reason of certain considerations which cannot now be gone into, that different numbers, representing the ratios of the weights of their respective atoms, may be attached, and thus we obtain a series of elements with atomic weights, ranging from that of hydrogen to those of the heaviest elements known. It is, moreover, found (as was first observed by Newlands in 1864) that if the elements are arranged in the order of their atomic weights, similar elements recur at definite intervals in the series. Thus they arrange themselves in several groups or "natural families," and the properties of the elements are said, mathematically, to be periodic functions of the

* See Lapworth, British Assoc. Address, *Nature*, Vol. XLVI., p. 377.

† For a general survey of earth-movements in the Western States, see C. E. Dutton, *Sixth Ann. Rep. U.S. Geol. Survey* (1885), pp. 183-198.

‡ "Das Antlitz der Erde," Bd. I., p. 778.

atomic weights. In view of the problem of the transmutation of the metals (which are elementary bodies) this classification is supremely interesting. As it is found that certain elements are more nearly related to those in the same group than to others, their transmutation, in the large number of such cases occurring, into a nearly related element, may be a problem which it is worth while to attack. Another consideration, moreover, is that, as the properties of an element depend upon its atomic weight, the elements, especially of one family, may possibly be regarded as built up from one another, or from some common material. Whatever relation amongst the elements this periodic classification may really indicate, it is probable that it has its origin in some unknown law concerning their formation; and it must be admitted that the hope of the alchemists, resting in their own time upon entirely false hypotheses, may, with the progress of chemistry, find its realization in some new field of modern investigation.

It is by means of the classification referred to that important suggestions were obtained which resulted in Dr. Emmens' startling discovery. As he himself describes it, his work had its origin in an attempt to prepare absolutely pure iron and pure nickel. In his investigations he obtained a new substance from iron and nickel different from anything before observed, and this substance was afterwards obtained in a similar manner from the element cobalt. Here, therefore, a substance is found which appears to be common to one of the groups of the elements, and, in itself, such a discovery is one of the greatest moment. Dr. Emmens has, however, proceeded to apply his method of investigation in another direction, and having regard to the fact that the gold and silver group offered the greatest reward to his labours if successful, he applied the same investigation to the series containing copper, silver, and gold.

It was previously known that silver could be made to pass into solution in water whilst still in a metallic condition, and it is considered that the element is, in this soluble form, reduced to extremely minute subdivisions. If such a process could be pushed further, the silver molecules, or smallest particles of silver as such, would become dissociated; and, as is observed in other cases, the body obtained exhibits new and remarkable properties. This further subdivision eventually succeeded in the case of silver, and a substance was produced which, in the opinion of Dr. Emmens, can no longer be regarded as the same element.

With this substance, moreover, a step further can be taken. It was found possible to group up the new substance into molecules of greater density than those of silver, and in fact to produce a new body which exhibited entirely different properties. It was yellow by reflected and green by transmitted light, and it was insoluble in either hydrochloric or nitric acid alone, but soluble in *aqua regia*, a mixture of these acids—thus possessing the characteristic properties of gold. It also resembled gold under the microscope.

The method of procedure has not yet been made known, but an actual transformation of one element into another is claimed to have been effected, and the claim is made by a chemist of scientific eminence and the author of several scientific works. The process is stated to depend upon mechanical treatment, and it is suggested that use may be made of the combined effect of impact and a very low temperature.

It is startling to consider what a wide field of investigation such a transformation opens up, and it suggests that a scientific problem generally regarded as insoluble may be successfully attacked when approached on entirely new lines. It does not seem improbable that several transmutations may, in reasonable time, be successfully accomplished, for we have little ground for regarding the elements as the ultimate particles of matter, except our inability to split them up further. But such inability may with future discoveries be overcome. At one time the alkalies, potash and soda, were substances which could not be decomposed, until Davy, with the galvanic current, separated from them the elements potassium and sodium. By analogy, we may regard the elements of modern chemistry as substances whose analysis resists the action of all known forces. Their formation in nature in the earlier stages of the world's history may have involved forces hitherto undreamed of by mankind; and who therefore can say what startling effects may result in the application of new conditions or of forces yet to be discovered?

THE TOTAL SOLAR ECLIPSE OF 1898.

IN the solar eclipse of 1896, August 9th, a very serious mistake was made by English astronomers in not occupying every available station. Throughout the breadth of Japan the weather conditions seem to have been unfavourable at the time of the eclipse, but on the western portion of the shadow's track the observers were massed, with two exceptions, within the Varanger Fjord in Finmarken. It is true that the meteorological prophecies were more favourable for the hour of the eclipse over this region than at either Bodo or Novaya Zemlaia. Indeed, at the latter place the chances seemed a hundred to one against a favourable sky. Nevertheless clouds screened the eclipsed sun to the many observers in the Varanger Fjord, and a most notable success crowned the efforts of the forlorn hope led out by Sir George Baden-Powell. At Bodo the heavens were also clear, but no observers equipped with any instruments were here available to tear their secrets from the seconds of totality.

It is much to be hoped that this experience, bought by bitter loss in Norway, may not be again to buy in India. Wherever attainable throughout the whole length of the shadow track, from Ratnagiri on the coast to Mount Everest on the Himalayas, no station should be left unoccupied by some observer, armed if he be but with pencil and note-book. For the north-east portion of the track this ought not to be a difficult matter. The zone of shadow here crosses over the thickly populated valley of the Ganges, is intersected by many railway lines, and is within easy access of several towns—such as Allahabad, Benares, Patna—which have very many European residents.

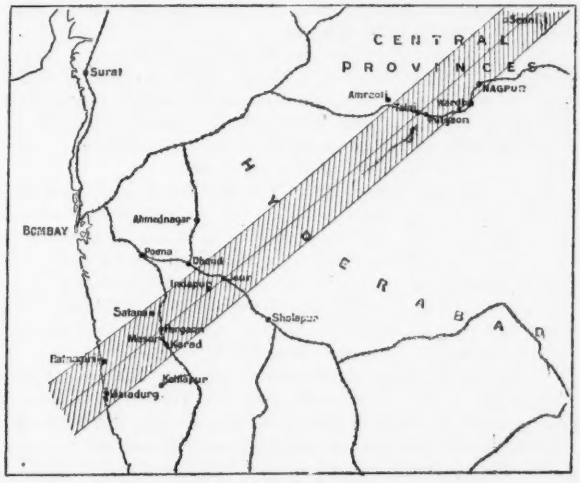
It will not be to the north-east part of India that the expeditions from England will in the main be sent. Where there are very many stations to choose from, the choice of an expedition coming from a long distance will naturally fall on that station which is most favoured by its astronomical or by its meteorological conditions, or, if possible, by both. In the case of the eclipse of January 22nd next, both of these conditions are most favourable near the western coast, and steadily decline together as the Deccan is crossed and the valley of the Ganges is reached, both being distinctly bad on the spurs of the Himalayas.

Beginning at the coast where the shadow track leaves the land of India, there is a small creek on the central line half way between the ports of Ratnagiri and Viziadurg. At this point will be anchored one of Her Majesty's gunboats, which has been told off to convey from Colombo

Sir Norman Lockyer and his assistants, Mr. A. Fowler, F.R.A.S., and Mr. W. J. S. Lockyer, Ph.D. By sailing from England to Colombo, and by securing there a man-of-war to take his expedition to the Ratnagiri coast, Sir Norman Lockyer at once avoids the troublesome quarantine restrictions imposed on those who leave Bombay and obtains the services of the gunboat crew in his observations. The services of men to whom promptitude and method have become a second nature are of the utmost assistance in the preparations and observations of an eclipse.

The main object of Sir Norman Lockyer's expedition is to photograph the spectra of the solar surroundings with prismatic cameras of six and nine inches aperture, and with an integrating spectroscope having two three-inch prisms of sixty degrees. An exposure of sixty seconds will be given with the integrating spectroscope, and exposures of varying periods with the objective prisms. Great success attended the use of such instruments in the expeditions of Mr. Fowler and Mr. Albert Taylor of 1893, and with a similar instrument at Novaya Zemlaia in 1896 Mr. Shackleton succeeded for the first time in photographing the "flash." Without doubt, the officers and crew of the gunboat will be also trained to make drawings, read thermometers, note the colours of the landscape, and other phenomena attendant on the eclipse.

Unhappily Her Majesty's ships are only in their element when at sea, and all the other expeditions which select inland stations cannot avail themselves of the services of gunboat or crew. The South Mahratta Railway, from Poona to Belgaum, crosses the central line of eclipse near the villages of Targaon, Masur, and Karad. At the second of these villages—Masur—in east longitude 74° 8′ 51″, and north latitude 17° 24′ 15″—the members of the expedition sent out by the British Astronomical Association hope to encamp. The duration of the total phase is here two minutes eight seconds, and the cloud statistics give a mean



Shadow Track of Solar Eclipse, January, 1898.

daily amount of about 1·2. A low range of highlands lie to the east of the village, upon which the camp will probably be pitched. This expedition is by no means as large as that sent out last year to Norway, but it nevertheless testifies to the energy and zeal of the members of the Association when the length and expense of the journey are taken into consideration, and the difficulties which any scientific expedition must undergo at this present time in India.

Of its members Mr. Thwaites, Mr. Evershed, and Mr. and Mrs. Maunder leave England on December 8th, and on arriving in India select the actual site for the Association's camp. Mr. Thwaites will photograph the corona with a four and a quarter inch Cooke triple object glass. Its focal length is about six feet and gives a diameter of the sun's image of about 0·6 inch. Mr. Evershed's programme is a large one. Two prisms each of sixty degrees angle, and with a combined deviation of eighty degrees, will be mounted before a two-inch object glass for varying exposures on the corona. An exposure during the whole of totality will also be made with a slit spectroscope containing two quartz prisms of angles sixty degrees and thirty degrees respectively. In addition, with a direct-vision spectroscope mounted on a three and a quarter inch equatorial, he will examine the prominence spectrum before and after totality, and will determine the moment of "flash."

Mr. and Mrs. Maunder's instruments consist of two cameras with object glasses of two and a half and one and a half inches, and giving images of nine-tenths and one-tenth of an inch respectively. Besides these there are two "Fowler" opera-glasses for direct vision of the coronal spectrum and the chromospheric "flash." Amongst other probable members of the party may be mentioned Capt. Molesworth, R.E., and Mr. Henry Cousens, Superintendent of the Archæological Survey of India.

The bulk of the members of the British Astronomical Association will arrive in India at a later date. Of these the Rev. J. M. Bacon introduces an entirely new weapon into the equipment of an eclipse expedition, in a kinematograph. This is a most powerful one, furnished and adjusted by Mr. Nevil Maskelyne—whose name has an historic connection with astronomy—and will furnish five or six photographs per second. Should this instrument give successful results the most complete series of photographs ever procured in an eclipse will be obtained, and should throw invaluable light on the question of stability or change in the corona.

At Karad, a few miles from Masur, will probably be the station of Dr. Michie Smith, the Director of the Government of India Observatory at Madras. He is preparing to photograph the corona with a forty-feet telescope of six inches aperture, using a polar siderostat, and he will also probably use some slit spectroscopes.

On the Great Indian Peninsular Railway line from Poona to Madras there will probably be encamped one or two parties. Prominent among these is the expedition organized by Prof. K. D. Naegamvala, Curator of the Observatory at Poona, whose principal instrument is a six-inch Taylor-Cooke achromatic lens with an objective prism of forty-five degrees angle and six by eight inches face. This will be fed by a twelve-inch cœlostat. In addition there will be a large single-prism slit spectroscope three inches in aperture used in connection with an eight-inch lens and twelve-inch siderostat; an objective prism of spar and quartz of two-inch aperture; an integrating spectroscope of small size for the spectrum of the total radiation from the eclipsed sun. Several photographs of the corona and direct visual observations of the meteorological phenomena will also be taken.

Entering the Central Provinces, the station of the second official expedition sent out by the Joint Eclipse Committee is at Pulgaon, a small village situated on the railway line from Bombay to Nagpur. Here Mr. Newall proposes to use a large slit spectroscope with two prisms of sixty-two degrees, in the attempt to determine the speed of rotation of the corona by the relative displacements of its lines as observed east and west of the sun. Mr. Newall does not

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propose to use the H and K lines, on which lines M. Deslandres photographed in 1893, but a bright line near G, of whose coronal nature there can be no doubt. In the same neighbourhood Captain Hills, R.E., will use two slit spectroscopes on achromatic Cooke lenses of four and a half inches aperture and with prisms of different materials and angles.

At or near Sohagpur, on the railway line from Jubbulpur to Bilaspur, will probably be located the third official expedition sent out by the Joint Permanent Eclipse Committee of the Royal Society and Royal Astronomical Society, and consisting of the Astronomer Royal and Prof. H. H. Turner. The Astronomer Royal will take the Thompson photoheliograph of nine-inch aperture and eight and a half feet focal length, with a secondary magnifier placed a short distance within the focus giving an image of the sun four inches in diameter. This will be fed by a cœlostat with a sixteen-inch plane mirror. Prof. Turner's instrument will also be fed by a similar cœlostat, and consists of a double camera, one of whose tubes contains the "Abney" lens of four-inch aperture and five and one-sixth feet focus, giving an image of the sun of 0·57 inch in diameter; the other is the photoheliograph objective No. 2, used in the Transit of Venus Expedition of 1874, and is of four-inch aperture and five feet focal length, giving an image one and a half inches in diameter after enlargement.

From Nagpur there is a good road stretching in the north-easterly direction to meet the centre of the shadow track at a distance of about fifty miles. At this point the Satpura Hills terminate, and this is the station which Dr. Copeland, the Astronomer Royal for Scotland—also sent out by the Joint Eclipse Committee—proposes to occupy. It may be remembered that on the rising moorland above the town of Vadsö, in the unsuccessful eclipse expedition of 1896, the "hundred-ton gun" in the Scottish camp of "Muckle Dreep" was a most conspicuous object. As it was manifestly impossible to mount the monstrous forty-foot tube in equatorial fashion in the short time available for the preparation of an eclipse expedition, it was fixed rigidly at its proper altitude and azimuth for the sun in mid-totality, and the photographic plate was made to follow the sun instead of the telescope. Let us hope that Dr. Copeland's great telescope will meet with better success on the sunny plains of India than in the mists of Finmarken, and that his notable success will be rivalled by that of all the other expeditions stationed along the central line.

Dr. Copeland will also use an object-glass prism during part of the eclipse in order to procure the spectrum of the prominences.

The American expeditions have probably suffered from the Yerkes dedication. Prof. Campbell, of the Lick Observatory, left California for India in the first week of October.

[November 20th.—The expedition of the British Astronomical Association will probably break up into two, possibly three, parties: one at Buxar on the Ganges, and one near Pulgaon.]

ARTIFICIAL SUNSPOTS.

By the Rev. A. East.

So much is being written on the subject of the elevation *versus* the depression theory of the constitution of sunspots, that it may not be amiss to draw attention to one point which, apparently, is occasionally overlooked. It is assumed sometimes that a spot, if sufficiently large in point of area, and relatively deep, ought to show on the extreme edge of the sun as a *notch* out of the edge, if it is a cavity at all; and the fact that spots are but seldom detected showing any such appearance is put down on the one hand as some proof that the spots cannot be cavities, and on the other that they must be relatively shallow.

To show that this is not necessarily the form which every large and deep cavity would take when seen on the edge of the sun, the two first photographs in the accompanying plate are given. As may be seen, they are taken from a wooden ball in which three holes have been made, and the ball is shown in two positions, representing the manner in which the spots on the sun are carried by rotation from one position to another. The great majority of persons, if asked, would probably say that a round hole in the sun would appear as a *bite* out of it when it got to the edge; but it will be seen that the appearance of a round or symmetrical spot seen on the edge is nothing of the kind, but is a *straight line*. It will be seen that, as the cavity reaches the edge, the limb becomes more and more flattened until it becomes at that place entirely flat, but never shows any indentation. These examples have, it is true, vertical sides, but a moment's consideration will show that a saucer-shaped cavity would behave in exactly the same manner so long as it remained circular.

And that this must be the case with every circular spot a simple illustration may make evident. The cavity of an empty barrel seen from above is circular; as the eye observes the top of the barrel more and more in profile, the cavity appears more and more elliptical, until, when the eye sees along the top of the barrel, the top is flat. Now take your barrel and plunge it up to the top rim in an imaginary sun, and turn the sun round until the barrel is on the extreme edge, and you get the appearance which a circular spot must present on the limb; and this, be it observed, is quite independent of the depth or shallowness of the cavity, but depends only on its regularity—that is to say, upon the edge being at every point equidistant from the centre of the sphere.

It follows from this that there is only one form of cavity (any form, that is, at all likely to occur) which can show us a notch in the limb, and that is a spot of valley-like form, whose length very greatly exceeds its width, and then only under the conditions that it is seen lengthways or in the direction of its major axis.

This consideration reduces the number of spots which could possibly be seen as a notch in the limb to an exceedingly small number; and when there is borne in mind the difficulty of seeing on the limb where there is any tendency to "boil," and the ease with which the exact moment may be missed, it will not appear wonderful that any appreciable notching of the limb so seldom comes to support the depression theory.

I may, perhaps, be permitted to add to the foregoing remarks an account of some experiments which I have lately made in order to elucidate some of the phenomena of sunspot formation. The flocculent appearance of the solar envelope is of course well known and often referred to, but the attempt to experiment with flocculent matter does not seem to have been made—owing, possibly, to its extreme simplicity.

First, then, as to the apparatus. A tin pan some twelve inches wide by three inches deep, a spirit lamp giving a small flame, and some flocculent material such as the curd of skim milk, or, by preference, some pulp of white paper softened by boiling, and rubbed fine in the hands.

The pulp is now mixed with clear water, and will represent for us the solar granules floating in the sun's atmosphere. The amount of flocculent matter must be consider-

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ARTIFICIAL SUNSPOTS.

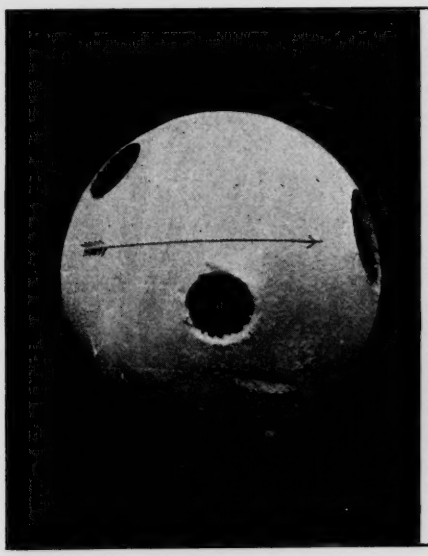

FIG. 1.—Wooden Ball, showing Rotating Spots.

FIG. 3.—An Ordinary Spot.

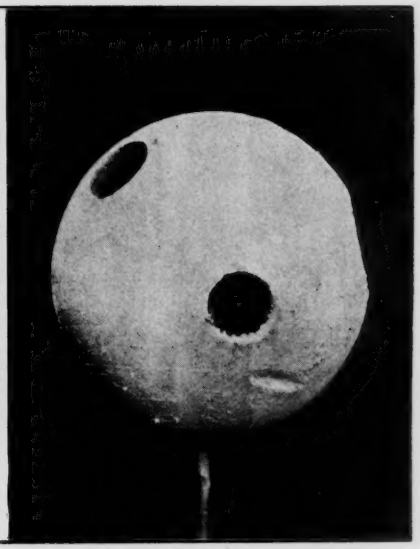

FIG. 2.—Wooden Ball, showing Spot on the Limb.

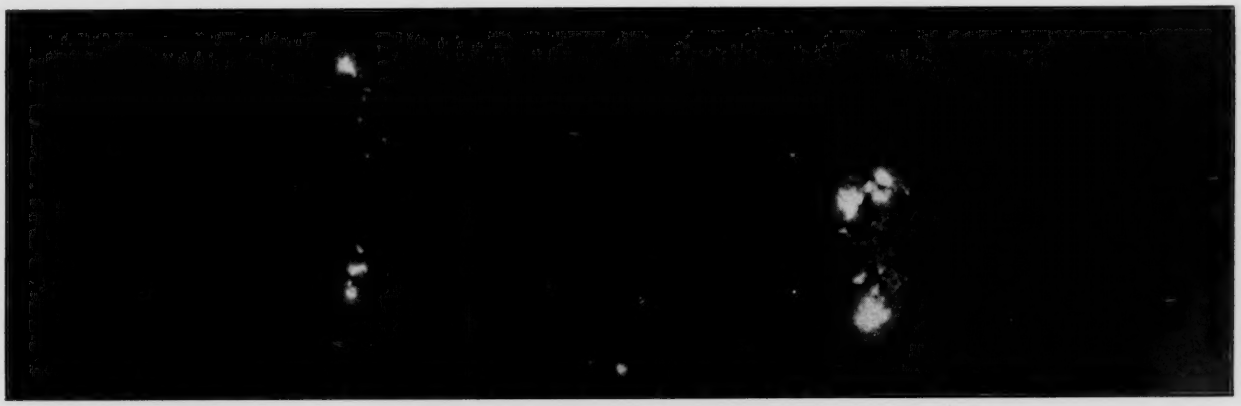

FIG. 7.—Part of a Photograph of the Sun, taken 1893, August, 9d. 10h. 19m. 25s. Greenwich Mean Time, at the Royal Observatory, Greenwich, with the Thompson Photoheliograph of nine inches aperture. (Negative image.)

FIG. 4.—An Active Spot.

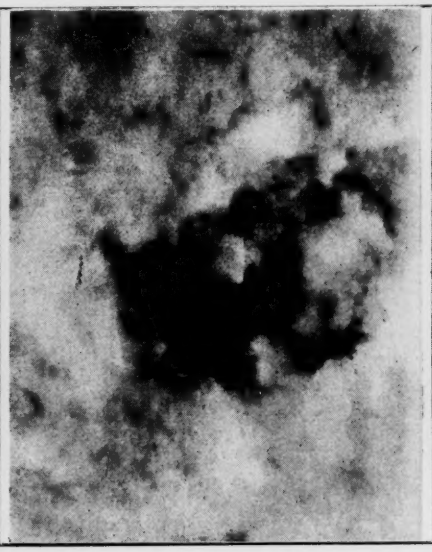

FIG. 5.—A Spot after an Upheaval.

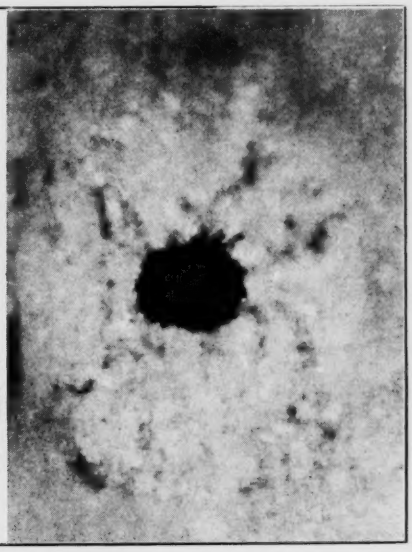

FIG. 6.—A Dying Spot.

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able compared with the water, or the results obtained will not be so good; the lighted lamp must be adjusted under the pan so that the point of the flame only reaches any particular place selected.

If the pulp has been well prepared the surface of it, which should be about one and a-half inches below the surface of the water, will present an exceedingly good likeness of the mottled face of the sun when free from spots. Very soon after the lamp is lighted, immediately over the point of flame, the surface will begin to rise—not always evenly but at times in folds—and the faculæ will appear raised above the general level, and manifestly brighter than the rest of the surface. If the lamp be now removed these faculæ will remain for a considerable time, and then slowly subside; but if the heat be continued the granules will part asunder, sometimes giving a small and simple spot, and sometimes (if the resistance be considerable) rising in great flocculent masses, leaving a great gaping hole, often with umbra and penumbra complete. As the heat continues other granules come up from below and stream across the chasm, and either float away over the face of our "sun," or remain as bright objects in the dark spot. Even the bridges are frequently reproduced with much fidelity. All this time the heated current is streaming up the "spot," and a curious effect, known to observers of sunspots, is produced by refraction—a certain haziness in the middle of the "spot" making seeing difficult. Now, if the lamp be moved a short distance to one side—say, two inches—from where it stood before, the hot current will still stream up through the same vent in our solar envelope; but now the current is oblique, and the umbra will no longer be symmetrical with the penumbra, and there is seen the well-known appearance of a spot which, although looked at full face and not in profile, as when travelling towards the limb of the sun, shows the penumbra much wider on one side than the other.

Now, if the lamp be removed the ascending current will flag, then cease, and at times a descending current will set in carrying with it a few floating granules. This descending current is especially noticeable when an active spot is working near it; and sometimes in a large spot both an ascending and a descending current may be observed at different parts of the same spot.

A spot when extinct will last a long time if undisturbed, but the sides will gradually fold over, not filling up from below, but closing in at the upper edge, the penumbra disappearing (Fig. 6).

At times, instead of any spot appearing over the flame of the lamp, there is a great upheaval, and masses of flocculent matter hang over the opening, entirely concealing it, whilst the heated fluid escapes at the sides.

One very curious effect may be obtained, but not easily. If the water is made of nearly the same specific gravity as the flocculent matter—say, by adding salt to the water—and the heat be applied equally to all parts underneath the pan; and if at the same time the granules are much reduced in number so as to float free from one another and no longer collect into masses—the granules will now form themselves into patches of a few inches area, divided from one another by well-defined straight dark lanes, and if carefully watched the granules will be seen advancing towards each other and disappearing down the dark lanes, whilst the middle of every patch is seen to consist of granules rising. A most interesting and almost exact representation of this curious arrangement of solar granules is given by Sir W. Huggins in Chambers' "Handbook of Astronomy," and in Sir Robert Ball's "Story of the Heavens."

One very noticeable feature in the behaviour of these artificial spots is the great variety of form assumed, and that this variety depends almost, if not entirely, upon the compactness or looseness of the granules. If too compact, no spot of any size forms, but the hot fluid rushes up through a small hole having neither umbra nor penumbra; if, again, the granules are very loose, still no spot will form, but the hot fluid will escape from below equally through many pores; nor, again, will any spot form if the heat be applied equally underneath, by interposing, say, a sheet of iron between the flame and the pan.

The results arrived at seem to point to some such conclusions as the following, some of which are in close agreement with the best accepted theories.

1. That spots are the result of comparatively small local concentrations of solar energy *below* the photosphere—that is to say, they are not primarily caused by the down rush of cooling vapours, which would not probably collect over any one area, but be dispersed over the whole solar surface.

2. That—startling paradox as it appears—a spot may be both an elevation and a depression at the same time! The faculæ may be seen to swell, rise, and open, appearing then as a mound with a gaping hollow. One thing must be borne very carefully in mind in comparing the telescopic appearance with the imitation, viz., that the solar granules, being self-luminous, cast no shadows to give the appearance of an elevation.

3. That unsymmetrical spots—*i.e.*, spots with the umbra not in the middle of the penumbra—are caused by the local energy being no longer immediately beneath the spot, the solar envelope having possibly travelled slower than the portion below; the original vent being still used for the uprushing vapours, which now come obliquely.

4. That spots can only be formed when the solar granules are compact; when widely diffused the remarkable arrangement noticed by Dr. Huggins and others will occur.

5. That the faculæ are upheavals of the photosphere having the same origin as spots, but which may or may not develop into spots.

6. That possibly the solar envelope in not always of the same depth. That at the times of minimum sunspot activity, when the granules are presumably least compact, it would be deepest; and at maximum, when the granules are most compact, it would be shallowest.

7. That the reason for the curious fact of the spots occurring in zones—*i.e.*, neither at the poles nor at the equator—may be attributable to the solar granules at the equator being too diffused by the action of the sun's rotation for spots to form, but too compact at the poles. If so, after a minimum period of sunspot activity, when the solar granules have been too diffused for spots to form, we should expect to see them form again first as the minimum is passing away where the solar rotation is less, namely, in high latitudes. This agrees with observation.

These may seem vast deductions from such small premises as a tin pan and the margins of old newspapers; but let anyone try, and he will be agreeably astonished at the wealth of information to be gleaned from the observation of these humble granules.

[It will not have escaped Mr. East that, if a sunspot be of the nature of a dark elevated cloud or of a dark surface stain, the "notch" appearance must be continually presented. The "notch" would, I cannot doubt, be much more frequently seen if it were carefully looked for.

Mr. East's most interesting experiments must, of course, not be pressed too far as furnishing analogies to solar phenomena. If we accept the analogy, it is clear that we must consider the interior of the sun, immediately below the photosphere, as much less brilliant than the photosphere. Here is the great *crux* of the sunspot problem: to explain how this can be possible.—E. WALTER MAUNDER]

British Ornithological Notes.

Conducted by Harry F. Witherby, f.z.s., m.b.o.u.

The Eggs of the Curlew Sandpiper (*Ancylochilus subarquatus*).—At the meeting of the British Ornithologists' Club held on October 20th, 1897, Mr. H. L. Popham exhibited a clutch of four eggs of the curlew sandpiper. Mr. Popham took these eggs, along with the female bird shot off the nest, on an island at the mouth of the Yenesei, on July 3rd, 1897. The eggs were laid in a hollow in reindeer moss. They are about the size and the shape of those of a dunlin, and are buffish green in ground colour and blotched and spotted with rich brown, especially on the thicker end. We take the opportunity of heartily congratulating Mr. Popham on his sensational find. Mr. Popham has already done a good deal of sound ornithological work, but nothing that he has done will make him more famous than the discovery of the first authenticated eggs on record of the curlew sandpiper. The eggs of the knot are now the only ones of any British bird which remain to be discovered.

Aquatic Warbler in Sussex and Hampshire.—On Tuesday, September 7th, while in my garden at 15, Highcroft Villas, Brighton, I saw and watched for some time a beautiful specimen of the aquatic warbler. It was very tame, and when first noticed was moving quickly about in a pear tree, and I supposed it to be a sedge warbler. As I approached, the bird came out on the side of the tree nearest to me, and sat at the end of a projecting branch, quietly watching me for two or three minutes. In this position I was able to examine it closely, and I saw at once that it was an aquatic warbler. The pale band down the middle of crown was quite distinct, and on each side of it two blackish lines, and the light line over each eye; also it had about five rows of minute dots on the breast. As it was so tame I went indoors for a butterfly net, thinking I might catch it, but on returning it flew away. On September 20th I had a beautiful specimen of the same species sent for preservation by the Rev. Scott, of Havant. It was caught by a fox terrier in Farlington Marsh, and is a male bird.—John Pratt, Brighton.

Occurrence of the Pectoral Sandpiper (*Tringa maculata*) in Holderness.—An adult male in summer plumage was shot by a coastguard on September 28th, on the margin of a pond on the fitties, near the Humber side, or Easington, in Holderness. This, a most beautiful and cleanly shot example, was seen by myself, Mr. Howard Saunders, and Mr. W. Eagle Clarke on the same evening, and it has now been presented by Mr. Clarke to the Edinburgh Museum. The one already figured in the late Lord Lilford's "Illustrations of British Birds" was shot near the same place on October 22nd, in 1888. This sandpiper has occurred more frequently in the British Islands than any other of the American waders, and no doubt has been very often overlooked when killed by the ordinary coast shooter in the autumn. In both the Spurn examples the first possessors were quite ignorant that they had got a rare bird.—John Cordeaux, Great Cotes House, R.S.O., Lincoln.

Herring Gulls and Guillemot.—With reference to the above note, if Mr. Cordeaux has relied on the evidence of the cliff climbers I fear the record is much vitiated as such—for, with the best intentions in the world, and without the slightest desire to deceive, these men cling most persistently to traditions handed down amongst them without taking the trouble to verify the facts for themselves. I, like Mr. Cordeaux, have picked up guillemots' eggs, fresh and unbroken, on the shore about Filey; but I have very good reasons for stating that the eggs are frequently dropped by the birds themselves in the water, in the same way that ducks and geese often drop their eggs; and, given calm weather and a smooth bottom, there is nothing remarkable in such hard-shelled eggs being washed up intact.—Oxley Grabham, Chestnut House, Heworth, York.

Mr. W. Foster, of 41, Belmont Road, Liverpool, also writes that he is confident that guillemots lay eggs in the water, and that he has never seen a gull carry off an egg in its feet.

Mr. F. H. Worsley-Benison writes that he has watched gulls at the Stack Rocks, in Pembrokeshire, "constantly flying around, and on every possible opportunity flying in and carrying off any egg that was partly or altogether exposed, but always in the beak. I never saw an egg carried in the feet." Mr. Benison adds that "it is certain that they carry off the guillemots' eggs *whole* in the beak. I did not observe on any occasion that the eggs were impaled on the beak."

[Limits of space preclude the insertion of any further letters upon this subject.]

A Strange Site for a Nightingale's Nest.—At Cranbrook, in Kent, there is a rifle range which is used by the local volunteers for rifle practice, and at a distance of about six feet behind the targets there has been built a large stack of faggots which serves to stop the spent bullets. This year a pair of nightingales selected the stack as the site for their nest, which they built in the interior at a distance of about fifteen inches from the surface of the front facing the targets, about four feet from the ground, and almost in a direct line with the centre of one of the targets, which are constructed of canvas and allow the bullets to pass through directly into the faggots. In that situation the birds built their nest, hatched their eggs, and reared their young, literally in the midst of a storm of bullets, one of which ultimately proved fatal to one of the youngsters. My informant was Colour-Sergeant W. Cogger, of the Maidstone company, 1st West Kent Rifle Volunteers, who very kindly furnished me with the particulars, and who, when acting as a marker, had every opportunity for watching the parent birds, who were engaged in feeding their young. Mr. Cogger told me that whilst he was in the butts at least four hundred bullets were fired at the targets, and the wood of the faggots was splintered in every direction round the nest.—J. Herbert Allchin, Maidstone, November, 1897.

Unusual Nesting Site of the Blackbird and Song Thrush.—On April 18th this year I was walking across Esher Common when I flushed a blackbird from off her nest, which was placed upon the ground amongst the heather and contained four eggs. About a yard from the blackbird's nest I flushed a thrush, and was surprised on looking down to find its nest, containing five eggs. Both nests were on the open heath, although some distance away there were plenty of bushes.—E. J. Kitchen, Battersea.

[The blackbird not infrequently builds upon the ground; the song thrush rarely does so.—H.F.W.]

Late Nesting of the Song Thrush.—As a proof of the mildness and warmth of the season for the last few weeks, I was shown a few days ago, by the gamekeeper at Abbot's Leigh, near here, a nest of the song thrush containing four eggs, upon which the hen bird had been sitting for several days.—George Harding, 9, Belle Vue, Clifton, November 8th, 1897.

Marsh Tits and Honeysuckle.—Is it generally known that the marsh tit eats the red berries of the honeysuckle?

These berries are juicy, and seem to contain none of that vegetable oil which tits enjoy; but the marsh tits regularly remove the ripe berries from the honeysuckle over my door.—CHARLES A. WITCHELL, Eltham.

NESTING OF THE SWALLOW (*H. rustica*).—At the close of April, 1885, during an action of ejectment by a pair of swallows against an intruding and pugnacious sparrow, their nest was dislodged from the eaves, fell, and was destroyed. After two days' examination of various positions they built a nest in a much-frequented out office, above the window, within two inches of the floor of the loft above, and within three feet of the head of anyone engaged at the table beneath. Here they reared two broods of five each, the whole party migrating on the 26th September. A pair returned on April 28th, 1886, to discover that a robin had taken possession. The question of tenancy not having been raised, they constructed another nest upon a beam a short distance away. In this they reared one brood; then built an additional nest against an adjoining floor joist, in which the second brood of five were reared, all leaving on the 24th September. From 1885 to 1897 careful watch has been maintained. It was noted that they arrived at early dawn between the 22nd and 29th of April in each year, and migrated between the 22nd and 29th of September—never earlier or later, except in 1891 and 1892, when they arrived on the 7th and 9th of May respectively. In 1892 two new nests were constructed and utilized—each brood reared in separate quarters. There are now four nests on the beam, which have been built and maintained in perfect repair by one pair of birds, and at present show no signs of neglect by the builders. It would appear from the above that the swallow sometimes divides a portion of the time between the incubation of the first brood and the advent of the second in constructing additional tenements, without neglecting the nurture of its young. It was observed that the male chiefly devoted himself to building operations, while assisting his mate in providing for the family.—W. DUNN, Withycombe, Exmouth.

Lesser Kestrel in Aberdeenshire (*The Field*, November 6th, 1897, p. 717).—Mr. Elton Lee reports that a female lesser kestrel (*Falco cenchris*) was shot at Boyndie, Aberdeenshire, in the last week of October. Although this bird is common in many parts of the South of Europe, we believe that this is but the fifth example recorded for the British Isles.

Noddy Tern in Cheshire (*The Zoologist*, November, 1897, p. 510).—Mr. F. Congreve has found, in a small collection of birds, an immature specimen of a noddy tern (*Anous stolidus*), which is said to have been shot on the Dee marshes some six years ago. As the noddy tern has only been obtained twice in Europe, it would be of the greatest interest to have some further evidence as regards this specimen. As the bird was shot so long ago, it would be difficult, perhaps, to decide if it was a truly wild one, or had escaped from some ship or elsewhere.

Black-winged Stilt in Somerset (*The Zoologist*, November, 1897, p. 511).—Mr. Stanley Lewis reports that a specimen of this very rare visitor—as regards the West of England—was shot at Sedgmoor in July, 1896, and is now in his possession.

Ferruginous Duck in Devon (*The Field*, November 13th, 1897, p. 788).—Mr. Tegetmeier reports the occurrence of the second example of this duck recorded in Devon. The bird, which is an adult male, was shot on November 8th, on Slapton Ley, and was identified by Mr. W. Jesse. It is remarkable that the only other example of this duck recorded for Devon was shot in the same locality in November, 1874, and was also identified by Mr. Jesse.

All contributions to the column, either in the way of notes or photographs, should be forwarded to HARRY F. WITHERBY, *at 1, Eliot Place, Blackheath, Kent.*

NOTE.—The first issue of KNOWLEDGE containing British Ornithological Notes was that for October, 1897.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

"THE LIFE HISTORIES OF THE BRITISH MARINE FOOD FISHES."

To the Editors of KNOWLEDGE.

SIRS,—Your reviewer has referred in such kindly terms, in your last issue (November 1st), to the conjoint work of Dr. McIntosh and myself upon "The Life Histories of the British Marine Food Fishes," that I feel sure it is unintentionally that he has done us an injustice. His remark with regard to the "spirit of rivalry" between "the North and the South," and its context, can imply nothing if not that we have ignored the work done by the southern biologists.

The implication is worded cautiously, but, following upon a direct accusation to this effect by Dr. E. R. Lankester in *Nature* of August 12th, it will certainly convey to your readers much more meaning than, I would believe, your reviewer intended.

The accusations made by Dr. Lankester were as unfounded as they were unworthy of so distinguished a zoologist; but the editor of *Nature*, with a partiality for which this magazine is not unknown, declined to publish any statement to this effect.

Under these circumstances I trust you will allow me to correct your reviewer's remark, as it naturally appears to corroborate the accusations referred to.

Dr. McIntosh and myself have spared neither time nor means in attempting to produce an epitome of the present state of knowledge in regard to the department dealt with, and it will be a matter of surprise if your reviewer can instance any of, *e.g.*, Mr. Cunningham's work which has not been alluded to and freely acknowledged. The name of this indefatigable worker alone occurs nearly a hundred times in the text, and all our sources of information have been freely acknowledged by hundreds of foot-notes.

I have elsewhere had occasion to allude to the way in which Mr. Cunningham has treated the labours of Dr. McIntosh, and, as far as I am aware, he has had at least a free opportunity, had he thought fit, to reply.

Dr. Lankester, and, to a lesser extent, your reviewer, have accused us of the very faults which I had to indicate in "Marine Marketable Fishes." The former has avoided the onus of supplying substantiating statements to this and to other serious charges, by the questionable but effective means of an editorial gag. I trust that in fairness to us you will allow the latter to at least indicate, in less general terms, wherein we have shown our inclination "to ignore, more or less, the work of the other" (*i.e.*, "the marine biologists of the South").

The University, St. Andrews, A. T. MASTERMAN.
November 5th, 1897.

[My remarks were general because they apply to the book as a whole. Throughout the volume the work of St. Andrews is put more prominently forward than work done elsewhere. This is, of course, not unnatural, and it seems to me that Mr. Masterman is ill-advised to assert otherwise. As an instance of work referred to in a way which deprives it of importance, the investigations of Mr. Cunningham on the growth of fishes may be cited. In this subject Mr. Cunningham led the way, yet no one would gather that such was the case from the manner in which it is dismissed by Messrs. McIntosh and Masterman. It may also be remarked that the credit of the discovery of the hermaphroditism of Myxine is in the book wrongly given to Dr. Nansen.

With regard to *Nature*, it is worth pointing out that no

reply of Mr. Cunningham to the criticism of his work on "British Marketable Fishes" was published, so that he, on the one side, may feel just as aggrieved as Mr. Masterman on the other. In any case, it is hardly in good taste for Mr. Masterman to make charges of partiality when both Mr. Cunningham's work and the one just published have been similarly treated in our contemporary.—The Reviewer.]

THE INTERNATIONAL CONGRESS ON THE PROTECTION OF BIRDS.

To the Editors of Knowledge.

Sirs,—The International Congress on the Protection of Birds, inaugurated at Aix-en-Provence on November 9th, under the auspices of the Ligue Ornithophile Française, of which M. Louis Adrien Levat is the able president, was concluded on Saturday last. The protection of insectivorous birds useful to agriculture was the chief matter treated of, and it was decided to forward to the Governments of Europe through the French Minister for Foreign Affairs the resolutions which were formulated. Public educational bodies are also to be memorialized in order to obtain, if possible, the serious consideration of this important subject by schoolmasters and Government school inspectors. Numerous French and Italian agricultural, horticultural, and sporting societies were represented at the Congress, and delegates from the Selborne Society and the Society for the Protection of Birds were also present.

Among the French societies which sent delegates were the Société d'Horticulture de France, Association Pomologique de l'Ouest, Société Centrale des Chasseurs, Société Protectrice des Animaux, and Société Protectrice des Oiseaux. Mr. Lemon and I had the honour of representing the Selborne Society and the Society for the Protection of Birds.

Hillcrest, Redhill, Surrey, M. L. Lemon.
17th November, 1897.

"THE MYSTIC NUMBER THREE."

To the Editors of Knowledge.

Sirs,—In connection with this subject, may I point out some remarkable peculiarities in the multiples of the number nine? If these are written down in columns up to nine times one hundred, as in the following table, a regular sequence of numbers appears, the figures on the right hand of each column being in reverse order to those on the left, and the central figures in each multiple of three figures also run in regular sequence, reading either up, down, or across the table. In fact, the table may be rapidly constructed by writing down the consecutive numbers from one to ninety in ten columns, repeating the number at the foot of each column at the top of the following one, and then placing the numerals from the cypher to nine opposite to them in reverse order, thus:—

0 9	9 9	18 9	27 9	36 9	45 9	54 9	63 9	72 9	81 9
1 8	10 8	19 8	28 8	37 8	46 8	55 8	64 8	73 8	82 8
2 7	11 7	20 7	29 7	38 7	47 7	56 7	65 7	74 7	83 7
3 6	12 6	21 6	30 6	39 6	48 6	57 6	66 6	75 6	84 6
4 5	13 5	22 5	31 5	40 5	49 5	58 5	67 5	76 5	85 5
5 4	14 4	23 4	32 4	41 4	50 4	59 4	68 4	77 4	86 4
6 3	15 3	24 3	33 3	42 3	51 3	60 3	69 3	78 3	87 3
7 2	16 2	25 2	34 2	43 2	52 2	61 2	70 2	79 2	88 2
8 1	17 1	26 1	35 1	44 1	53 1	62 1	71 1	80 1	89 1
9 0	18 0	27 0	36 0	45 0	54 0	63 0	72 0	81 0	90 0

As a consequence of this sequence the figures, when read diagonally on the above square (omitting from the multiples of three figures the units, which are, of course, consecutive), an arrangement may be produced in which the figures reappear in numerical order, as in the following table:—

Diagonals from left to right commencing at the top—

0	10	20	30	40	50	60	70	80	90
1	11	21	31	41	51	61	71	81	
2	12	22	32	42	52	62	72		
3	13	23	33	43	53	63			
4	14	24	34	44	54				
5	15	25	35	45					
6	16	26	36						
7	17	27							
8	18								
9									

The figures in each product in the first table, when added together, produce nine or some multiple of nine, however far the table may be carried.

A. G. Moncreiff Grahame.

2, Walpole Terrace, Brighton.

To the Editors of Knowledge.

Sirs,—In the article on "The Mystic Number Three" in your current issue you refer to the "mysterious and unaccountable properties of the number," described in a paper published by the Asiatic Society of Bengal, and quote as an instance the fact that "when any number is multiplied by three, or any multiple of three, as six, nine, twelve, etc., the separate figures in the result, if added together, give a total of three or a multiple of three"; or, in other words, that when a number is divisible by (*i.e.*, a multiple of) three, the sum of the digits of the number is also divisible by three.

Your mathematical readers will know that this is not quite so "unaccountable" as it appears, and to others the following may be of interest as throwing some light on this particular instance of the "mysterious."

Suppose $a\,b\,c\,d$ to represent any number in the ordinary system of notation, *i.e.*, a, b, c, and d each represents a single digit, the whole being equivalent to

$$a \times 1000 + b \times 100 + c \times 10 + d = a\,10^3 + b\,10^2 + c\,10 + d.$$

Now, it is obvious that any power of ten may be expressed by writing as many nines in succession as there are units in the number representing the power in question and adding unity; thus, $10^3 = 99999+1$.

Hence, $a\,10^3 + b\,10^2 + c\,10 + d$ may be written—

$$a(999 + 1) + b(99 + 1) + c(9 + 1) + d$$
$$= a\,999 + b\,99 + c\,9 + a + b + c + d.$$

Obviously, the first three terms in this expression are divisible by three, each being a multiple of nine.

Hence the whole expression will be divisible by three if, and only if, the remaining portion—that is, the sum of the four digits of the number—is divisible by three.

As this method of reasoning is applicable to any number whatever, it is, I think, fairly obvious why, when a number is divisible by three, the sum of its digits is also so divisible.

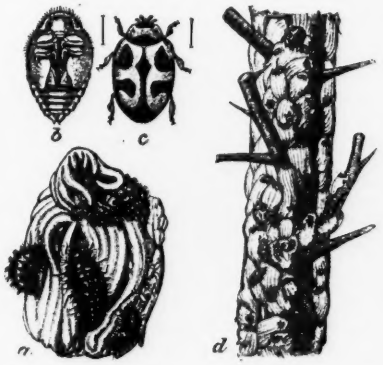
November 16th, 1897. G. Harcourt Hill.

Science Notes.

Mr. F. Enock, whose name is so familiar to readers of this magazine, will deliver a Christmas course of lectures at the London Institution. The subject of his discourses is—"Insects at Home, at Work, and at Meals."

Dr. Fewkes, explorer for the American Bureau of Ethnology, has described the site of a city that once belonged to the Funii tribe—a city probably as populous as that of Rome under Severus, and built as one huge house constructed in tiers like the cells of a honeycomb, forming the walls and fortifications of the city on the outside, the windows and doors opening towards an inner court.

The most destructive insect enemies of fruits in California are undoubtedly the scale insects (*Coccidæ*). Many methods are employed by fruit growers in California to control the ravages of injurious insects of this and other kinds, as may be seen from a paper in the "Year Book" of the United States Department of Agriculture. But one of the most satisfactory is the importation of natural enemies of the noxious species. A few years ago the very existence of citrus culture in California was threatened in consequence of the attacks of the white scale (*Iceyra purchasi*). A ladybird enemy of the pest, *Vedalia cardinalis*, was, however, introduced into the State from Australia, and it did its predatory work so thoroughly that the white scale is no longer an important injurious insect. The accompanying figure, reproduced from the paper to which reference has been made, shows this ladybird and its larvæ. This noteworthy instance of the almost total eradication of an injurious insect by the importation of its predaceous enemy has given great confidence in the natural means of controlling insects. Enormous numbers of different varieties of ladybirds have been introduced, and one of them, the little beetle *Rhizobius ventralis*, has entirely exterminated the black scale insect (*Lecanium oleæ*) from several badly infested orchards. There can be no doubt about the beneficial influence of these beetles at present, and the results furnish a striking instance of the industrial application of the facts of entomology.



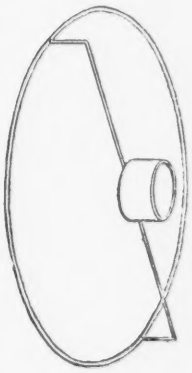
Vedalia cardinalis (the imported Ladybird enemy of the White Scale): *a*, Ladybird Larvæ feeding on Female Scale; *b*, Pupa, and *c*, Adult Ladybird; *d*, Orange Twig showing Scale and Ladybirds, natural size.

A school of ethics and social philosophy has just been formed, the general committee including the Master of Balliol, Mr. Leslie Stephen, Prof. Sully, and others. Special attention will be given to the bearing of recent psychology upon problems of education, and to the philosophical analysis of the structure of society and the functions of its organs. Lecture rooms have been secured at the new Passmore Edwards settlement in Tavistock Place, W.C., and the secretary, *pro tem.*, is Mr. J. H. Muirhead, 30, Aynhoe Road, West Kensington.

A very useful volume of classified and illustrated abridgments of specifications relating to philosophical instruments, 1884-88, has just been issued by the Comptroller of Her Majesty's Patent Office, and we understand that similar volumes on other subjects and groups of subjects are obtainable. To those persons requiring information as to what is already protected in the way of invention by letters patent these volumes must be a real boon. The laborious process of searching through the records of the Patent Office is by this means reduced to something like ten per cent. of what it used to be, a concise and understandable short paragraph, as a rule, taking the place of many whole pages in the full specification.

A trial journey in a motor car over a distance of a hundred miles on the Carlisle road has been accomplished in eight and a half hours, including stoppages. The amount of fuel consumed was five gallons, the total cost, including lubricating oil, being 4s. 10d. for the hundred miles. Three passengers were carried, and the net cost per passenger was therefore about 1s. 8d. for the journey.

The experiment of floating a steel needle upon water is an old one; nevertheless it is easier described than successfully performed. It is often stated that the needle must be greased, but this is a mistake, for to float a needle upon water its surface should be quite clean. Shortly before his recent death, it occurred to Prof. Alfred M. Mayer that by floating a disc or ring of metal with a chemically clean surface, and gradually weighting it until it broke through the surface of the liquid, the surface tension could be measured. The discs experimented upon were made of aluminium; they were one-twenty-fifth of an inch thick, and from two to three inches in diameter. Discs of these dimensions could not only be made to float upon water, but a small extra weight had to be added to them in order to make them sink, and the water surface was depressed by about one-tenth of an inch before the discs broke through it. To determine the weight necessary before a ring of metal breaks through a liquid surface, an arrangement of the form shown in the accompanying figure was used. Prof. Mayer found that if a floating ring of this kind, formed of wire about one-twenty-fifth of an inch in diameter, be gradually loaded by pouring fine sand into the cup carried by the ring, it sinks deeper and deeper into the depressed surface of the water till it has reached a depth of one-tenth of an inch, when it suddenly breaks through the surface and sinks, as in the case of the discs. Using the data thus obtained, the surface tension of the water can be calculated. It was found that all metals, with clean surfaces, from platinum, having a density of 21·5, to magnesium of a density 1·7, float on water. The reason appears to be that a film of air coats the surfaces of metals and keeps them from touching the water.



In a recent issue of the *Statist* there is an article on "The World's Gold Production since 1850." A chart is given showing the variations in production in each year from 1851 to 1896. For the latter year the production by fields was as follows:—United States, £10,000,000; Australasia, £8,988,000; Transvaal, £8,604,000; Indian, £5,911,000; Russia and other countries, £10,697,000—or a total of £45,000,000. The grand aggregate of the gold production since 1850, inclusive, is, in round figures, £1,163,000,000, or approximately 300,000,000 ounces of gold.

Expectations as regards the Leonids have so far been anything but realized. Watchers in many parts have, so to speak, cast their nets and caught nothing. Those who were fortified with cameras and eagerly scanned the heavens about the time of the expected display, found meteor and shooting-star catching quite an unexciting recreation.

M. Czernich, the well-known Russian chemist, has examined two minerals from the Caucasus. One of them

is a kind of coal, the ashes of which contain a considerable quantity of the new element helium. The other is called cerite, and consists of the new element argon. These two new elements have never before been found in minerals in a pure state, but only in chemical combination with other elements.

M. Cailletet has presented to the Paris Academy of Sciences a memoir on apparatus for measuring the altitudes of balloons, and a means of verifying the results. An aneroid barometer is employed, and photographs are taken at two-minute intervals of the earth and of the aneroid, and it is asserted that the true height can be easily calculated.

M. Berthelot has recently published a memoir describing some mirrors of Gallo-Roman origin, dating from the third or fourth century, in which the reflecting surface is lead, which appears to have been applied in the molten state to the glass.

The International Congress of Zoology is to meet in Cambridge on August 23rd, 1898. An executive committee has been appointed, composed as follows:—President: Sir John Lubbock, Bart.; Vice-Presidents: The Vice-Chancellor of the University of Cambridge, Dr. W. T. Blandford, Sir W. H. Flower, the President of the Linnæan Society, Prof. Ray Lankester, Prof. A. Newton, Dr. P. L. Sclater, the President of the Entomological Society, Sir William Turner, and Lord Walsingham; Treasurers: Prof. S. J. Hickson and Dr. P. L. Sclater; Secretaries: Prof. F. Jeffrey Bell, Mr. G. C. Bourne, and Mr. A. Sedgwick; Ordinary Members: Dr. H. Gadow, Mr. F. D. Godman, Lieut.-Col. Godwin-Austen, Sir G. F. Hampson, Dr. S. F. Harmer, Prof. Howes, the Hon. W. Rothschild, Mr. H. Saunders, Prof. Seeley, Dr. D. Sharp, Mr. A. E. Shipley, Prof. C. Stewart, and Dr. H. Woodward. The official address of the Congress is, by the courtesy of the Zoological Society, 3, Hanover Square, London, W.

An invention which seems likely to render telegraphic communication as direct and private as is telephonic has been displayed to a select company in Berlin. It has been called "Telescripter" and takes the form of an electric typewriter. The apparatus can be electrically connected by means of a call-bell with any other similar apparatus, and the message, which is typed off through the keyboard at one end, will be reproduced in plain letters and numerals on a plate at the other end. The "Telescripter" will do for writing what the telephone effects for speech, and the publicity and complexity of ordinary telegraphic business will be done away with.

Messrs. Newton & Co. have on their list some very interesting series of magic-lantern slides. Amongst these may be mentioned a series of English, Spanish, and Dutch birds and nests, photographed from life by Mr. R. B. Lodge. The photographs of a buff-backed heron on a branch of a tree, and of a grey shrike on a shrub, are very clever; whilst those of a night heron's nest and eggs, and of a young spoonbill, are both interesting and artistic. We understand that Mr. Lodge went to Spain and Holland on purpose to obtain these photographs, and he has certainly been very successful.

We would direct our readers' attention to the following letter from Mr. Chas. Louis Hett, of Springfield, Brigg:—

A short time ago I heard a bird-call which I did not recognize, beyond remembering that I had read of it a few days previously. I searched the volume without success, and the identity of the bird remained undecided. It then occurred to me that an alphabetical list of recorded bird-calls would prevent the recurrence of a similar experience. Acting on this idea, I have now collected from the works of Messrs. Beckstein, Dixon, Kearny, Morris, Robinson, Swann, and Dr. Emerson, the calls of two hundred birds, or rather more than half of those which are accepted as British. I am very desirous that my list should be as complete and perfect as possible, and shall greatly esteem any co-operation which you can give me, either in checking calls already recorded, or supplying those of other birds, more particularly of any bird or birds which you may have had favourable opportunities of observing. . . . . I have frequently retained two or more spellings of a single call. This appears to be unavoidable, as our language is not phonetic, and many bird-calls may be spelt in different ways with equal approximation to correctness. I have also retained some very free renderings of calls which approximate to English sentences. Although the "call-bird" portion is complete as far as I have the materials, I have as yet only had the first page set up. If my appeal for co-operation meets with the response for which I hope, I shall at once finish the compilation, and see it through the press.—Chas. Louis Hett.

As Mr. Hett remarks, bird-calls may be spelt in English in different ways. This fact, and the similarity of many call notes, renders it impossible in most cases to identify a bird unknown to the observer merely by its note. We do not think Mr. Hett can possibly collect every spelling of every note, since almost everyone spells a call note differently. However, the work will, no doubt, be of some value as a means of identifying birds, if used in conjunction with other data. We do not think that Mr. Hett has gone to the best authorities for his information.

Dr. A. A. Kanthack, the eminent bacteriologist, of St. John's College, has been elected to the Professorship of Pathology, in the place of the late Prof. C. S. Roy.

The medals of the Royal Society have been distributed as follows: the *Copley*, to Prof. Albert von Kölliker; the *Davy*, to Dr. J. H. Gladstone; the *Buchanan*, to Sir John Simon. The *Royal* medals have been awarded to Prof. Andrew Russell Forsyth and Lieut.-General Sir Richard Strachey.

At one time it was supposed that a delicate membranous envelope, known as Ascherson's membrane, held the fat globules of milk, and the theory was advanced that the violent concussions induced by churning caused the rupture of these delicate bladders and set each microscopic particle of butter free, thus facilitating the running together of the oily contents. Fresh evidence, however, militated against the belief in this envelope, and the theory gained ground that the globules of fat were merely suspended in the milk in a naked condition, and that when they become aggregated into large granules in the process of churning, they run together in much the same way as globules of quicksilver on contact with one another. Storch, a competent Danish investigator, has recently brought forward evidence which invests the membrane theory with a new lease of life. The chief evidence which he adduces is that of staining the membranous envelope by means of a solution of picro-carmine, so that under microscopic examination the globules, colourless in themselves, were seen to be surrounded by a narrow faint-red border. The average thickness of the membrane is calculated to be about one-twentieth of the diameter of the globule, each globule consisting, as a whole, of 72·5 per cent. of pure fat and 27·5 per cent. of albuminous membrane.

Dr. Aitken, in his presidential address to the Edinburgh Botanical Society, in which he described an experiment during the summer at the Botanical Garden as a means of testing the value of *nitragin** as supplied by the patentees in Germany, says that the substance from which so much had been expected was without any appreciable influence upon the growth of beans in pots in a cold frame in the garden.

* *See* Knowledge, September, 1897, p. 201.

Obituary.

WE regret to have to record the death on September 14th, at the age of eighty-two, of the Rev. Andrew Matthews, of Gumley, Market Harborough. Mr. Matthews had been an earnest student of natural history during nearly the whole of his long life. His collections were large, and contained many very valuable and interesting series both of insects and birds. In 1849, in conjunction with his brother Henry Matthews, he published "The History of the Birds of Oxfordshire and its Neighbourhood." In 1872 he published a work entitled "Trichopterygidæ Illustrata," written in Latin and illustrated by himself in thirty-one plates, detailing the full anatomy of this family of almost invisible insects. His other works have been "Essay on the British Species of the Genus Mylloena," 1837; "Synopsis of European Trichopterygidæ," which appeared in the French magazine *L'Abeille;* and "A Synopsis of the Trichopterygidæ of America." In 1888 he was engaged in a description of his branch of natural history for the great American work on the "Natural History of Central America" (Godman & Salvin). In his eightieth year he completed a second volume of "Trichopterygidæ Illustrata," fully illustrated by his own hand from microscopic dissections of these minute beetles. This work is now in the publisher's hands. After the publication of the first volume of "Trichopterygidæ Illustrata" he was offered the honour of the Fellowship of the Royal Society of England, which, however, he declined, "lest his scientific acquirements should be estimated by the number of letters after his name."

Peter Lund Simmonds, who was proprietor and editor of the *Technologist*, 1862-66, and the *Journal of Applied Science*, 1870-81, died recently, aged eighty-three, in the Charterhouse, where, in reduced circumstances, he found a refuge among the brethren. Mr. Simmonds was a voluminous writer on agriculture, food supplies, and commercial matters generally. His best known work, "Waste Products and Undeveloped Substances," went through many editions.

THE BEAVER IN NORWAY.

By R. LYDEKKER, B.A.Cantab., F.R.S.

HAD not the use of its hair in the manufacture of hats been superseded by that of silk, there is little doubt that the beaver, both in the Old World and in America, would by this time have been numbered among extinct animals. As it is, the creature has but a hard time of it at best, for although there is no longer a demand for its hair by the hat manufacturer, yet beaver fur is an article highly valued by the furrier, and equally highly esteemed by the fair sex. Although a few survive in the Rhone and the Rhine, while more numerous colonies are found in parts of Russia, the beaver has been practically swept away from most European countries, though place names frequently bear testimony to its former presence. Among the countries where it still maintains a foothold is Norway, but of late years little information has been forthcoming as to the approximate number of beaver in the country, or their mode of life. We are, therefore, glad to welcome a booklet by Dr. Robert Collett, the well-known Zoological Professor at the University of Christiania, published by the Bergen Museum, and dealing with the present condition and habits of the Norway beaver. As it is illustrated by twelve excellent photographs of the haunts of the beaver, the reader can obtain a good idea of the kind of country affected by these animals, and can also see for himself their mode of working.

It appears that for some years the beaver has enjoyed a certain amount of protection in Norway, and if this protection be continued, Dr. Collett is of opinion that the animal will survive well into the next century. The two most important colonies now remaining are situated at Aamli and Nedrethelemarken, and both of these have recently been visited by the author.

The Norwegian beaver began to decrease in numbers from the early part or middle of the last century, and by 1800 had already disappeared from most parts of the country, with the exception of the northern districts of Finmark and Nordland, and the southern province of Nedenas, or Christiansand. The work of extermination went on more or less rapidly till the year 1845, when it was somewhat checked by the enactment of protective statutes; but either these could not have worked very effectually, or the war of extermination had been only too well carried out, for in 1880 the number of individuals surviving throughout the country was estimated at only about three score. Three years later the number of head was put down roughly at a hundred, and since that date it is probable that the number has been fully maintained, if, indeed, it has not actually increased.

The statutes which have been enacted for the preservation of the beaver in Norway are not, for the most part, of a very effectual nature, and have a decidedly feudatory smack. The statute of 1845 provided that no beaver at all should be killed for ten years, and then only by the proprietors of the estates on which they were found. This was admirable as far as it went, but as from the beginning of 1856 proprietors were again allowed to kill, without either restriction as to time or number, it is obvious that the good results of the first enactment might very well have been speedily lost. Probably this was found to be the case, as in 1863 a fresh statute was propounded, establishing a close time and fixing a limitation in number. According to this statute, beaver were only allowed to be killed during the months of August, September, and October, and then only by owners of estates, who were permitted to kill but one individual annually on each separate estate.

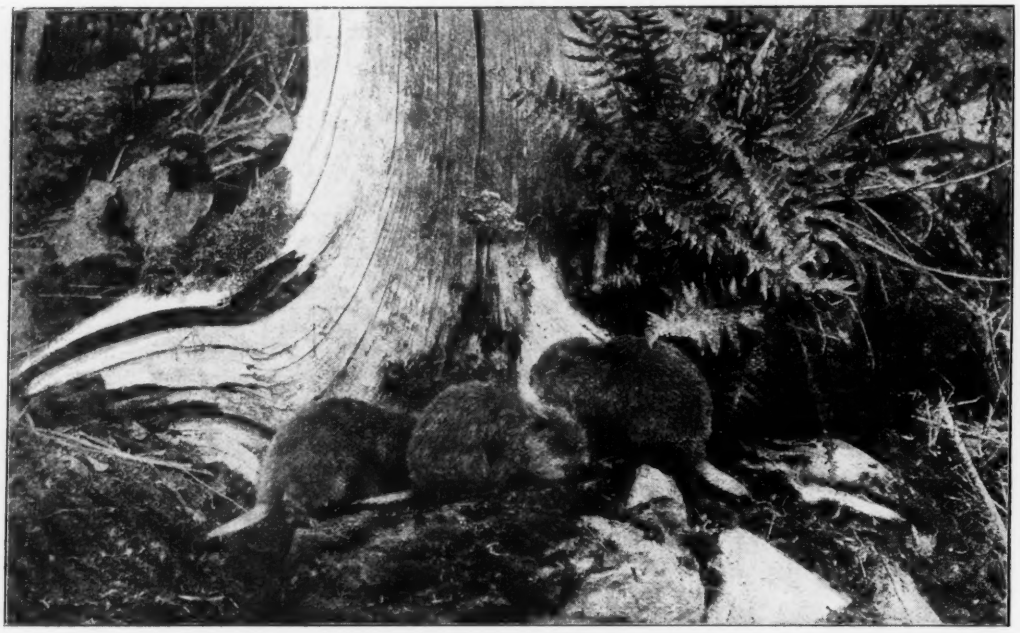
Special exemptions might, however, be granted by the Sovereign, who was enabled to give permission for the killing of several individuals on large estates, or even to permit the proprietors to kill the whole number of animals on an island or enclosed property; thus putting some of the colonies, like the one at Aamli, entirely in the power of the owner. Moreover, although slaughter is entirely forbidden on Crown or municipal lands, beaver might be killed to any extent, and apparently in any number, on private estates where they inflicted appreciable damage.

Two much more effectual statutes have, however, recently come into operation: the one, dated August 31st, 1894, protecting all the beavers in the Amt of Sondre Bergenhus till the end of 1904, and the other, dated September 3rd, 1895, doing the same for the colony of Aamli till the end of 1905. The penalty for illegally killing beaver is a fine of eighty kronors (about £4 10s.), which can be inflicted on all the participators in the offence.

The chief food of the beaver in Norway consists of the fresh bark of deciduous trees, more especially the aspen; the larger branches being barked, but the twigs consumed entire, and the coarse bark of the trunk generally rejected. For winter use small branches are sunk near the entrance

to the lodge, but no store of stripped bark is collected. Most of the trees felled are situated close to the water, with beaten tracks leading to them from the lodge, but occasionally some are chosen a considerable distance away from the river. The trees are gnawed all round until the portion left is so thin that the stem breaks from its own weight; the stump remaining being generally about half a yard in length, and terminating in a point like a pencil, as does the lower end of the felled stem. Small trunks or branches are, however, gnawed in a slanting direction. Only healthy trees are selected for felling, and sometimes these are left half gnawed through without any apparent reason. No attempt appears to be made to make the trees fall in any particular direction, as they may be seen lying pointing all ways. The trunks and boughs, after being stripped of their bark, are cut into convenient lengths and employed for building, the current being used for their transport whenever practicable. Many lodges are, however, constructed in still water, and the animals are then compelled to convey the timber by their own exertions; this being effected by holding the log in the water between the fore paws, and swimming with the hind feet.

The construction of the lodge is a serious business, occupying at least two years; and annual repairs are necessary to keep it in a habitable condition. Building operations take place in the autumn, lasting from September till well into November; and as they are nearly always undertaken at night, it is but seldom that an opportunity occurs of seeing the animals at work. In Norway the lodges are either conical or elliptical in shape, the majority being now of the latter type. The conical lodges, which appear to have been more common formerly than they are at present, are placed on the banks of ponds in which the water level is constant, such ponds being either natural or made by the animals damming up the stream. On the other hand, the elliptical or elongated lodges are invariably formed on the banks of a river with running water subject to constant change of level. Although the majority are considerably smaller, they may be as much as fifty feet in length; the width seldom exceeding eight or nine feet. One half generally lies under water, and thus prevents the edifice from being left high and dry when the river runs low. The main entrance is invariably placed at the end of the submerged portion, but another outlet may be made on shore beyond the lodge itself, and is then generally covered with a layer of twigs, or twigs and earth. As a rule, the lodges are isolated, although a couple may be built in contact. Seen from a distance the lodge looks like a confused pile of timber and earth, without any definite arrangement. The logs employed are usually from a couple of feet to a yard in length, although they may sometimes be double this size; twigs are also largely used, and sometimes take root and develop into saplings on the roofs. Stones are but seldom employed.



Young Beavers, three weeks old, from the Lodge at Fladen, Norway.
(From "Bæveren i Norge," by R. Collett.)

Many of the logs are stripped of their bark, but others are built in just as they are felled; and not unfrequently drift logs of pine and other trees which are men-felled are annexed. The logs and twigs are thrown together pell-mell, and the interstices tightly rammed with earth, the thickness of the walls being about a couple of feet. The passage leading from the submerged edge of the lodge to the central dwelling chamber is usually single, and about twenty inches in diameter; its interior, when in clayey soil, becoming worn perfectly smooth.

A double lodge opened by Mr. Collett in 1895 is described by him as follows:—"The left or short lodge contained an unoccupied chamber without lining. The right, which was long and of considerable age, extended for some way under an oak coppice. The chamber in this was situated about six yards from the water, half a yard underground, and consisted of an enlargement of the passage to about three-quarters of a yard in height." It was thickly lined with the under bark of the aspen.

Ice-floes and floating timber do much damage to the lodges, and thus entail an annual repair, which, as already said, is carried out in autumn. Spring and autumn floods also frequently submerge the lodges, from which large portions are loosened and swept away. From twenty to thirty years is the probable period during which a lodge is habitable.

On the bank of the river in the neighbourhood of the lodge numerous burrows are to be met with, a few of which are in connection with the former, although most are entirely separate. Burrows are the first refuges formed by the beaver when taking possession of a fresh spot, and they may accordingly be likened to the rude sheds erected by workmen employed on building a mansion. Probably each lodge is tenanted only by a single couple and their young family; the young beavers, when able to do without parental assistance, either settling down temporarily in burrows in the immediate neighbourhood, or wandering away to found new colonies. Small lodges constructed in

Aspen (*Populus tremula*) felled by the Beaver (Aamli).

a kind of jerry-building fashion appear to be run up by bachelor beavers who have not yet ventured to take upon themselves the responsibilities of a wife and family. There may, however, be also spinster beavers to whom such accommodation is also necessary—it is to be hoped only temporarily.

Dams are constructed where beavers have quartered themselves by the sides of gently flowing streamlets, or small posts through which a current runs, in order to obtain water of sufficient depth and maintaining a constant level. The "bund" is substantially built and difficult to demolish. One examined in 1895 was constructed at the outflow of a small stream through a forest marsh; and where there was formerly but a small shallow pool, a pond or lake of some few hundred yards in diameter soon resulted from the labours of these indefatigable rodents. The "bund," which was about fifteen feet in length, with a cross section of some two feet, was entirely made in the course of three weeks during the summer of 1890. In Canada, when the dam is sufficiently stout, the pool will eventually silt up and form a "beaver-meadow," but Mr. Collett does not record any of these "meadows" in Norway.

During the cold winter months the beavers, although not hibernating in the proper sense of the term, pass what appears a somewhat dull existence in the central chamber of the lodge, the roof of which for most of the time is buried in snow. Sometimes, however, when the weather is mild for the season, and an unusually cold autumn prevented the completion of the annual repairs at the proper time, the beaver will venture out from their retirement for a short period in order to remedy such dilapidations as stand in urgent need of immediate attention. When they have been engaged on such works their footprints are visible in the snow. Immediately after the breaking up of the ice in spring the animals issue forth to procure a fresh supply of food and resume their daily avocations.

The young beavers are born in April or May, three being apparently a common number in a litter. At first their eyes are closed, but they grow rapidly, and by September or October are about the size of a cat. When able to shift for themselves they leave the parental lodge, and frequently start off to found a family in some fresh locality, although sometimes they set off on their wanderings alone. Following the courses of small streams, they frequently tack straight across the open mountain slopes for many miles, so that one or more not unfrequently make their appearance in valleys where none have been known for years. They will even occasionally cross small arms of the sea; and the perils of the journey end in death to no inconsiderable number.

Several old-time superstitions still cling round the beaver. One of the most persistent and most incorrect is that the flat sealy tail is employed as a trowel for plastering down the mud during building operations. Another is that the secretion of the tail glands—the *castoreum* of the old pharmacopœia—has the property of frightening away whales or porpoises when approaching a boat! Still more strange is the old idea that some individuals were compelled to lie on their backs and be laden with building materials, when they were dragged by their companions to the scene of operations. Probably this fable originated from the circumstance that many individuals have the hair worn off the back from constantly passing up and down the narrow burrow or entrance to a lodge.

Notices of Books.

Botanical Microtechnique. By Dr. A. Zimmermann. Translated from the German by James Ellis Humphrey, S.D. (Archibald Constable & Co.) By the publication of an English edition of Dr. Zimmermann's work, a most excellent treatise on a subject of wide interest is placed within the reach of students. Books already existing on the same subject are wanting in directions that are a distinguishing feature of the present volume. Although of necessity it must be a compilation from various original papers and text-books, it is not an unsystematic collection of formulæ. The methods of dealing with each component part of a plant are prefaced by a description of the chemical composition and structure of these parts. The intelligent student, working at any given process, has thus the necessary data at his disposal to appreciate the reaction that takes place, and to try possible variations and improvements. There is a short but useful chapter on staining bacteria, and the numerous references comprise all the recent literature of value. The book can be recommended as a complete and well-arranged treatise on a subject of considerable importance.

In Russet Mantle Clad. By George Morley. (Skeffington & Co.) Illustrated. 10s. 6d. Mr. Morley dedicates his

handsome book to the Countess of Warwick: "In token of her kindly friendship, these scenes of idyllic life in Warwickshire—the work of my hand with my heart in it—are, by her permission, very gratefully inscribed." It certainly was not intended that man should live perpetually in four-walled structures; still, the majority of the human race dawdle most of their time away under such artificial conditions. We have here a series of sketches which will please many a lover of country life. The scenes are depicted by the author direct from nature, and are located in Warwickshire. There are six sketches containing many interesting bits of information, and written in homely language, mingled with the colloquial phrasing of Shakespeare's country. The author is a keen observer of human nature, but he is all at sea when writing of birds. He describes the characteristic flight and action of a kestrel hawk, but he calls the bird a "sparrowhawk." As a whole, the book presents a good idea of humble life in Warwickshire, and will be appreciated by those who care for this sort of literature.

The Vertebrate Skeleton. By S. H. Reynolds, M.A., F.R.S. Illustrated. (Cambridge University Press.) The title of this book is hardly comprehensive enough for the matter contained, a somewhat larger field being covered by including some animals which are not strictly vertebrates. As the author says, in a short preface, the plan adopted is to give an account of the general skeletal characters of each group and of its several subdivisions, to describe in detail the skeleton of one or more selected types, and to treat the skeleton as developed in the group organ by organ. Perhaps an improvement might have been effected by putting the chapters in different order, as their sequence is not that best suited for the instruction of a beginner; but this is a minor matter which is amply compensated for by the able treatment of the subject. The illustrations are fairly numerous and in all cases well and carefully selected. Many are drawings taken from photographs of specimens in the British Museum and Cambridge University Museum of Zoology. The book is one that can profitably be used by students of the subject.

Lessons in Elementary Biology. By T. Jeffery Parker. (Macmillan & Co.) Illustrated. 10s. 6d. A good deal of controversy has occasionally arisen as to the way in which biology should be taught. Some, like the late Prof. Huxley, advocate starting with the higher animals and proceeding downwards; others—and they are in the majority—advise the student to commence with the lower animals and go step by step up the biological ladder. In the book before us the author commences with the lower organisms first, a plan which, at any rate, commends itself to us. Of course, there are substantial reasons for and against pursuing a course of biology on either of these different lines; but when one looks thoughtfully into the matter, it seems most natural to pass from the simpler to more complex, or what is known as synthetical biology. Never forgetting the valley of the shadow of the coming examination, it is always a matter of primary importance to find the path of least resistance in preparing class books of this kind. Some new matter has been added to this—the third—edition, and also some forty additional illustrations. Prof. Parker's book is essentially a laboratory guide, and all the drawings, exceedingly good of their kind, are structural views, not pictures, of the subjects treated. Both zoology and botany are included, and representatives of each chief division are thoroughly investigated individually and comparatively.

Tables for Facilitating Computation of Star-Constants as Arranged by E. J. Stone, M.A., F.R.S., Modified and Revised by H. H. Turner, M.A., B.Sc. (Frowde.) 2s. The original supply of copies of Mr. Stone's well-known tables having been exhausted, Prof. Turner, who was then giving his attention to the question of shortening the process of calculating "star corrections," came to the conclusion that a re-issue of Mr. Stone's tables—the excellence of which has been abundantly established by experience—would meet the case if the tables were shortened by confining them to three places of decimals instead of five. It has been found that in actual use this gives all needful accuracy, whilst the rapidity with which the work can be carried out is much increased. The tables are clearly printed and neatly arranged, and the book is rendered more complete by an appendix giving the day numbers of the *Nautical Almanac* for 1897, 1898, and 1899, modified for use with them.

Diseases of Plants induced by Cryptogamic Parasites. By Dr. Karl Freiherr von Tubeuf. English Edition by William G. Smith, B.Sc., Ph.D. Illustrated. (Longmans, Green, & Co.) This book, although an addition to an already large mass of similar literature, undoubtedly fills a pressing want. It is devoted not merely to a description of the various pathogenic fungi, slime fungi, bacteria, and algæ which are parasitic on the higher plants, but also enters into the wider field where parasites and saprophytes are, as the result of environment, scarcely to be distinguished from each other. The book has also considerable commercial value, as, in addition to the purely scientific interest in the subject, it will be of use to those who are engaged in the cultivation of plants, for it indicates the best methods by which the parasites can be destroyed, or prevented from developing, without injury to their host. The work is furnished with many excellent illustrations, largely photographic, which are almost exclusively the work of the author, taken from living objects. It is evidently not intended to replace existing systematic works on the same subject, but is rather an addition to them. The references given are up to date, and will therefore be found serviceable.

An Illustrated Manual of British Birds. By Howard Saunders, F.L.S., F.Z.S. Second Edition. Illustrated. Part I., price 1s. (Gurney & Jackson.) We heartily welcome the first part of the new edition of Mr. Saunders' manual. It is now about eight years since the first edition of this exceedingly useful work was published. Many rare birds have been recorded for the British Islands during the last eight years, and it will be the author's task to incorporate all authenticated and valuable records in this new edition, which is to be thoroughly revised and brought up to date. The first part (the book will be complete in twenty monthly parts) is excellent in every way. The same classification as in the former edition will be adopted in the present one, and for this we are thankful, since we shall be able to refer to the book without using the index. The description of each species is limited to two pages as before, and the same illustrations, with the exception of about thirty new ones, will be used. To those who are unacquainted with the first edition of the manual, we would say that it gives all the essential information on British birds in the smallest possible space, and that it is absolutely reliable. We hope to refer to the work again when further parts have been published.

Elements of Descriptive Astronomy. By Herbert A. Howe, A.M., Sc.D. (New York: Silver, Burdett, & Co.) Illustrated. 7s. 6d. This work, described by its author as a text-book, is admirably adapted for the use of students who know a little algebra and plane geometry. Prof. Howe deals with the usual subjects with great clearness and some freshness of style. A most valuable feature of the book is the admirable series of questions which are placed at the end of each chapter—questions which the student will not be

able to answer directly from the text, but will require time to think over carefully what he has learnt, and to deduce the answer by the exercise of his own reasoning powers. The illustrations, too, merit a word of praise; several of the best of recent photographs and drawings are here reproduced, and there are a large number of neat and clear diagrams. As in "The Study of the Sky," one is struck from time to time by the occurrence of a quaint flash of dry humour, most unusual in a student's text-book, which seems to bring one into pleasant contact with the author. Thus he remarks on the recent explanations of the canals on Mars: "It is better not to know so much than to know so many things that are not so." There are a few minor details which are open to criticism. Mr. Packer's alleged photographs of the corona in full sunshine ought hardly to have been dignified by a reference. Prof. W. H. Pickering's observations of the satellites of Jupiter might also have well been omitted. There are also a few slight inconsistencies. Prof. Schiaparelli's value of the rotation of Venus is unhesitatingly accepted; but if, as Prof. Howe tells us three pages later, Venus owes its brilliancy to the fact that its sky is almost totally cloudy at all times, it is clear that the elements for deducing its rotation period are wanting. A large amount of important information is given in the appendices, but that on the landmarks in the history of astronomy must be regarded as decidedly incomplete, whilst a more important one—a list of reference books—shows some lack of judgment in one or two particulars.

The Ascent of Man. By Prof. Henry Drummond. Sixth Edition. (Hodder & Stoughton.) 3s. 6d. This book, the work of the late Prof. Drummond, is too well known to need many remarks here. It formed the subject of the Lowell Lectures, and, as a matter of course, does not enter very deeply into the subject, but as regards the marshalling of facts the book is a masterpiece of English erudition. The author displays a wonderful acquaintance with the resources of modern science, and has contrived to impart a new air and character to an old theme. Aided by a vivid imagination, combined with what may be styled literary diplomacy, he has evolved a singularly inoffensive presentment of many bitter controversial phases of so-called evolution; and it is, perhaps, not too much to say that the author has attained a large measure of success in his attempt to construct out of a heterogeneous jumble of theories one which has some claim to be regarded as a continuous and harmonious whole.

SHORT NOTICES.

Manual of Ethics. By John S. Mackenzie. (University Correspondence Press.) Third Edition. 6s. 6d. The present edition of this work has been re-cast and brought up to date. It is intended, primarily, for London University students, but it is also a handy book for general readers. The author endeavours to treat of ethics without a knowledge of metaphysics, and not unsuccessfully. Metaphysics is a most difficult subject to comprehend; indeed, Kant said that "it was a science that had not yet come into existence." A hasty perusal of the several chapters fully convinces one as to the author's deep and comprehensive knowledge of ethical science. He gives plenty of references, which, in a work of this character, are indispensable. It is doubtful, however, whether the considerable additions in Book I., on the development of the moral life and the moral judgment, increase the value of this new edition, as, in our opinion, there is now too much overlapping with the kindred sciences—sociology and psychology.

Theories of Magnetism and Electricity. By Charles E. Curry, Ph.D. (Macmillan & Co.) 8s. 6d. An effort is here made to further extend the general theories of magnetism and electricity put forward by Maxwell, Helmholtz, and others. The student, in order to derive benefit by reading this book, must have undergone a thorough training in mathematical science, including the calculus and higher geometry. The whole subject is treated theoretically, and has a very forbidding appearance. Naturally, the mysterious and paradoxical ether comes in for a large share of Dr. Curry's attention, classifying different states of the ether or classes of particular integrals corresponding to these states, and so simplifying the difficulty encountered in grasping the ether-agent itself.

Elements of Chemistry. By Rufus P. Williams. (Ginn & Co., Boston and London.) Illustrated. 5s. We are informed that this book is the outcome of the author's wide experience with students of chemical science. He endeavours to treat the subject in an interesting manner, and really makes the study of chemistry a pleasure, and at the same time a mental exercise. Such subjects as valency, molecular and atomic weights, are made clear to the student; but we should point out that the spelling of a great many of the words is at variance with the usual mode adopted in the majority of chemical text-books. We may mention that the book is not designed for any special examination, but rather with the view of giving students in general a good, practical introduction to this useful science. The volume is profusely illustrated by excellent outline figures, showing arrangements of apparatus and correct modes of manipulation.

Practical Histology. By Edward Albert Schäfer, LL.D., F.R.S. (Smith, Elder, & Co.) 7s. 6d. Second Edition. Dr. Schäfer's book is already well known and highly esteemed. Histology may be regarded as a separate branch of the science of biology—that is, the microscopic study of animal and vegetable tissues—and the author has borne in mind the needs of private students, and therefore copious instructions are given as to the methods of mounting microscopic slides, and many other details associated with the delicate operations of the microscopist. A work of this character would be useful to students of research, so exhaustive and suggestive are the experiments, hints, and instructions here set down. The illustrations, though good, are too sparsely distributed—inordinately restricted to manipulation, and an almost total disregard for seeing.

Outlines of Physics. By Edward L. Nichols. (Macmillan & Co.) Illustrated. 7s. 6d. This book is intended for beginners in the science of physics. Like a great many of the present-day text-books, it combines theoretical with practical work, only more minute instructions are given as to the methods of conducting experiments. Beginning with the subject of physical measurements, the author goes on to mechanics, heat, electricity, magnetism, sound, and light; the above being the order in which they are dealt with. It is now a settled conviction that a course in physics is of little use without a practical acquaintance with physical instruments and methods. The book is eminently suitable for such a course. The illustrations are exceedingly well drawn, and the type is clear. The whole book seems to be the work of a sound, practical teacher, and it may, therefore, be recommended to the notice of teachers and students of physics.

Progress in Printing and the Graphic Arts during the Victorian Era. By John Southward. (Simpkin, Marshall, & Co, Limited.) 2s. 6d. In this elegantly designed retrospect of the development and progress of the printing and kindred arts during the past sixty years, Mr. Southward has contributed a most interesting and instructive addition to the literature of the record reign year. Perhaps in no other field of industrial activity have we reaped such far-reaching results as in that of the printing press, but the distance we have travelled is not realized until we come to compare the periods and contrast the materials, the appliances, and the workmanship then and now. Such a contrast, plainly set out and well illustrated, Mr. Southward has brought before us.

A curious work entitled "The Science of the Ideal" has been forwarded to us. The so-called *ideal* here finds its expression in colours, forms, and numbers, which are held to form the basis of memory, and to constitute the vitality of synthetic philosophy—a plan of applying the ideal for the interpretation of the real. Man, mind, and nature, as here set forth, appear to have for their respective complements, professions, thought, and the universe. Colour, form, and number are supposed to form a *triad* to which man, mind, and nature are in some way subordinated, and the theory is so elaborated that it forms a skeleton key to many difficult problems—so we are given to understand. We should add that the science was "inferated by Major Davis, indicated by Prof. Wilson, and intimated by F. J. Linford-Wilson."

We have received from Messrs. William Wesley & Son a classified catalogue of upwards of three thousand works on botany in all its branches. The value of such a list to students and teachers must be apparent to all, and especially so as a means of selecting book prizes in the several departments of botanical science; while to the compiler its use as a time-saving work of reference will, we think, be universally appreciated. Also similar catalogues of works on zoology and astronomy are to hand. These lists embrace all sorts of books, old and new.

BOOKS RECEIVED.

Lessons from Life—Animal and Human. By Rev. Hugh Macmillan, LL.D. (Elliot Stock.)

The Evolution of the Idea of God. By Grant Allen. (Grant Richards.) 20s. net.

Infinitesimal Calculus. By Horace Lamb, F.R.S. (Cambridge University Press.) Illustrated. 12s.

Wild Traits in Tame Animals. By Louis Robinson. (Blackwood) Illustrated. 10s. 6d. net.

The Lost Gold of the Montezumas. By Wm. O. Stoddard. (Hodder & Stoughton.) Illustrated. 5s.

A Popular Introduction to the Study of the Sun. By Geo. McKenzie Knight. (Geo. Philip & Son.) 1s.

A Bibliography of Norfolk Glaciology. By W. Jerome Harrison. (Reprinted from the *Glacialists' Magazine.*)

Random Shots at Birds and Men. By Jim Crow. (Roxburghe Press.) 1s.

Light: Visible and Invisible. By Prof. S. P. Thompson. (Macmillan.) Illustrated. 6s. net.

Life Histories of American Insects. By Clarence Moores Weed, D.Sc. (Macmillan.) Illustrated. 6s. net.

Theoretical Mechanics. By A. E. H. Love, F.R.S. (Cambridge University Press.) Illustrated. 12s.

A History of Fowling. By Rev. H. A. Macpherson. (Edinburgh: David Douglas.)

The Reliquary and Illustrated Archæologist. Volume for 1897. (Bemrose & Son.) 12s. net.

Astronomy. By Agnes M. Clerke, A. Fowler, and J. Ellard Gore. (Hutchinson & Co.) Illustrated. 5s.

Studies in Psychical Research. By Frank Podmore. (Kegan Paul.)

Cheltenham as a Holiday Resort. By S. S. Buckman. (Norman, Sawyer, & Co, Cheltenham.)

The Elements of Hypnotism. By Ralph Harry Vincent. (Kegan Paul.) 9s.

Physiography for Advanced Students. By A. T. Simmons. (Macmillan.) Illustrated. 4s. 6d.

The Rise of Democracy. By J. Holland Rose. (Blackie & Son.) 2s. 6d.

Chemistry for Photographers. By Chas. F. Townsend, F.C.S. (Dawbarn & Ward.) Illustrated. 1s. net.

With Nature and a Camera. By Richard Kearton. (Cassell & Co) Illustrated. 21s.

Open-Air Studies in Botany. By R. Lloyd Praeger. (Griffin & Co.) Illustrated.

Open-Air Studies: an Introduction to Geology Out-of-Doors. By Prof. Cole. (Griffin & Co.) Illustrated. 8s. 6d.

THE BRITISH TRAP-DOOR SPIDER.—II.

By Fred. Enock, F.L.S., F.E.S.

THE form of the tube inhabited by the British trap-door spider varies according to age. An immature male or female spider makes a parallel burrow, but on reaching maturity—which in the female is not attained for some years—she enlarges her burrow at about half way down, on the upper side, making a cavity an inch or more long and a quarter of an inch deep (*see* Fig. 1, p. 251). Across this she slings a hammock of the finest floss silk spun from the smallest pair of spinnerets (Fig. 7). In the hammock she then lays from one hundred to one hundred and fifty eggs, of a very pale yellow colour; these are laid during the summer, and hatch in the autumn into spiders which cast their swaddling clothes before emerging from the hammock later on. The mother broods over her young, and, so far as my experience goes, she always seems to have them well in hand during the winter months; but on the approach of warm weather in April she in some way intimates to them that it is time they emerged from the maternal home, to go and find their own living—which they do in exactly the same manner as taught them by their mother.

On reference to Fig. 6 we notice the wonderful mechanism of the jaw, which internally is lined with bands of striated muscle, the ends being bound round the termination of the joint of the long fang. At the tip of the jaw, embedded in the muscle, is to be seen the poison bag and duct, the latter running through the ball-and-socket joint and down the hollow fang, from which the poison flows through a minute aperture, placed just before the sharp point. The lower jaws, to which are attached the palpi, are somewhat thumb shaped, opening laterally at right angles to the movement of the *upper* jaws, which are thrown up in much the same manner as a navvy working his pickaxe.

How this spider obtained its food was for a long time a complete puzzle—only to be solved by careful observation. When living at Woking, I found this spider exceedingly plentiful about the uncultivated commons, where they had not been noticed in any way. For many years it was commonly supposed that this spider fed upon earthworms. One author went so far as to write: "I frequently surprised *Atypus* in the act of holding earthworms in their falces"; but before this could have been seen the nest must first have been dug up, and, if so, I cannot understand how the spider would retain its hold after the tube had been torn open.

No doubt earthworms, in their subterranean borings, might occasionally come into contact with the tube of the trap-door spider, and then the inmate would seize hold of the worm. In fact, I have tried the experiment several times, and found that as soon as the worm pressed against the silken tube the spider caught hold of it, and, in spite of its twisting about, pulled it through to the bottom of its burrow, where a great scuffle went on, resulting in the worm being cut up into mincemeat by the terrible jaws of the spider.

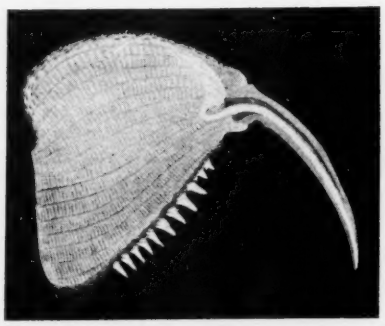


Fig. 6.—Mechanism of the Jaw of the British Trap-door Spider, showing Fang and Poison Bag.

Having such facilities for studying the habits and economy of small animals, I soon had a large colony of trap-door spiders established in a bank of turves which I built up at the bottom of my garden. Here I was enabled to watch them day and night without interference. Each tube was numbered, so that I could give an account of each one's doings from day to day. On capturing a very large female I turned it out upon a sheet of paper, upon which it had great difficulty in walking, its large body dragging so much—and it had not the power to raise it. Touching the spider with a blade of grass caused it to lose temper! Cautiously I repeated the annoyance, and noted that the spider immediately raised its cephalo-thorax—or shall I say its "head"?—in a most threatening manner. I applied the stem again, with the result that the two huge jaws were thrown up vertically, the fangs, too, unfolding from beneath, while the lower jaws, armed to the edges with a most horrible array of spikes, were opened wide—so wide that I could look right into the throat! On further application of the grass stem the diabolical machinery was closed with a snap, and the stem severed in two. The movement was so interesting that I caused it to be repeated several times upon two thicknesses of blotting paper, which was pierced right through by the fangs; a penholder was also marked. Then, when the anger of the spider was furious to behold, I offered the tip of my finger to soothe it! This was quickly seized, the fangs (an eighth of an inch in length) were driven in up to the hilt, while the spikes on the lower jaws rasped across on the other side. The

spider evidently appreciated a taste of my blood, for it held on most tenaciously, endeavouring to cut through my skin and make its teeth meet. This I allowed it to do, when it seemed soothed, and I left off teasing it. During this practical exhibition I had come to the conclusion that the purpose of these immensely developed fangs was to drive them through the silken tube. With this idea I took my seat opposite to a large tube in the home colony. After waiting and watching several days, I was rewarded by seeing the fang suddenly darted through the aërial portion and as quickly withdrawn, and again repeated. Searching over the part with my magnifier, I at last discovered a minute beetle on its back, just at the ground line, where it was quietly endeavouring to right its position by kicking out its tiny legs—occasionally touching the spider's tube—quite sufficient to disturb its nest by setting the delicate threads in motion. I immediately

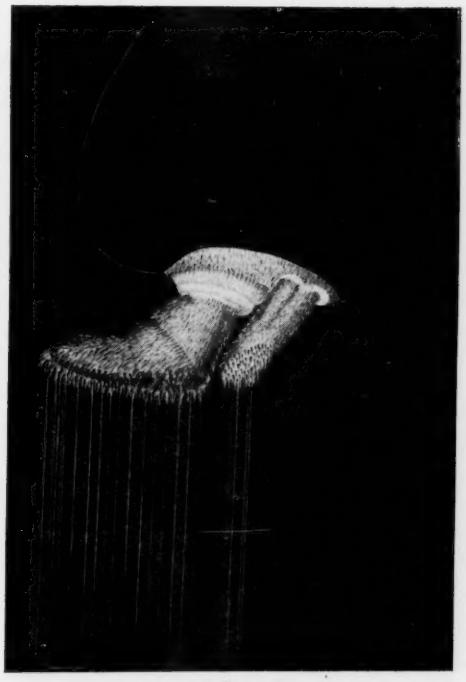


FIG. 7.—Large and small Spinnerets of the British Trap-door Spider.

caught a large blowfly (Fig. 8), and, holding it by its wings, I allowed it to kick at the tube. Before this had been repeated the huge fangs were darted through with unerring aim, right into the head of the blowfly (Fig. 9), their motion reversed, and clenched tight with a cruel crunch. A few moments' pause and then the spider commenced to pull backwards (Fig. 10), until it made a large rent in the tube, through which the blowfly was dragged down to the lower regions of the tube (Fig. 11). Before I had noted down my observations, I noticed the torn edges in the nest were being moved from the inside—quietly drawn together; then I could just detect the large spinnerets "taking hold" of the edges and darning up the rent! A few turns up and down, then all was quiet, and scarcely anything to tell of the tragedy just enacted. The following day I found that this spider had sanded over the rent, and completely obliterated all signs of damage.

Having some thirty nests in my home colony, I commenced experiments in the food supply confirming the first. I also tried the effect of presenting a large humble bee *tail* first! The spider seized this, but was wonderfully careful in so manipulating it that, without seeing the bee (the aërial part being quite opaque), she managed to turn it completely round until she had firm hold of the head; *then* she promptly pulled the humble bee through and down. One very warm day I caught a blowfly, which I held to the tube. The occupant came up, drove its fangs through, sampled the fly, and then commenced to pull through—when I immediately ran up the garden, caught another fly, and ran back before the spider had reascended to mend the hole. On seeing the second fly she positively started with surprise, no doubt astonished at the impudence of the thing; however, she seized and dragged it through at one movement. I left for the top again, and was back again with a third fly. Again the spider came up to mend the rent, but finding another fly so upset her intentions that she appeared to lose her temper, and seized the fly almost passionately. Away I ran to obtain another, and

FIG. 8.—Blowfly on the Silken Tube of the British Trap-door Spider.

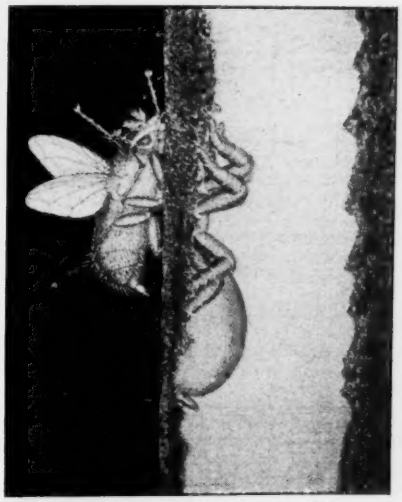


FIG. 9.—Blowfly seized by the Spider.

so on until the spider had taken no less than nine blowflies!—which now were getting scarce, and on reaching the nest with the tenth fly I found the aperture closed. I tapped it with the head of the blowfly, when the spider rushed up and struck her fangs through *an inch below* the fly, holding the tube in a close grasp, as much as to say:

"Go away; I don't want any more!" She held on for more than an hour, when I went away. The next morning I found that she had thrown out five of the old skins of the flies, and the remaining four followed the morning after. All kinds of insects are thankfully received by the trap-door spider, who sometimes has to go without food for a long time. During winter the aërial part of the tube is much flattened by snow—so much so that on the return of spring the spider is unable to distend it, and so starts another. She therefore forms another aërial portion, and thus makes a forked tube. I once found one having no less than five aërial tubes. This fact caused me to think that the trap-door spider lived to a great age.

Fig. 10.—The Spider dragging the Blowfly through a rent in the side of the Silken Tube

The garden spider hatches from the egg in April, mates in August, lays her sack of eggs in September, and *dies*, thus making the cycle of her life not much more than six months. I have kept individual female trap-door spiders for *seven years!* Some of these were anything but babies when I first caught them. Owing to my nomadic habits I have not yet been able to hatch a brood and carry the members through their natural lives; but now, having greater facilities, hope to settle this question. Once I kept a female alive two years and a half *after* she had brought up and turned out a family of only one hundred and twenty! I had not the opportunity of finding a second husband for her, so she died in widowhood.

Fig. 11.—The Spider retires with its Prey.

After the male spider has reached maturity he becomes a wanderer for a time, but not for long; he soon finds the nests of the female. The courtship of these spiders is interesting to watch. This I was enabled to do by filling a glass jar with sand rammed very tight. I then inserted a piece of cane, driving it down close to the side; withdrawing it, I polished the glass side of the hole made, and turned in a large female, which did not make herself at home for some time; and from her inability to obtain soft sand she was obliged to leave the silken lining semi-transparent, which enabled me to see all her actions.

This one was in a large bell glass—all alone. Having been fortunate in digging a number of immature males, I reared them to maturity, and placed one on the sand in the bell glass. The spider trundled round until its toe came into contact with the aërial part of the nest of the female. In a moment the male seemed aware of the fact, and after a short pause commenced to beat a kind of serenade upon the outside of this tube. This was kept up for some time, no notice being taken of it from the inside; but had a fly engaged in such rhapsody it would have paid the penalty with its life. Not so the male; he continued his tattoo until, growing impatient, he deliberately tore open the rest with his long fangs and quietly descended. The next day the rent was properly mended. The pair lived together for nearly six months; then a terrible tragedy was enacted in the semi-darkness of the deep burrow. I *saw* the female dart her fangs into the head of her husband—

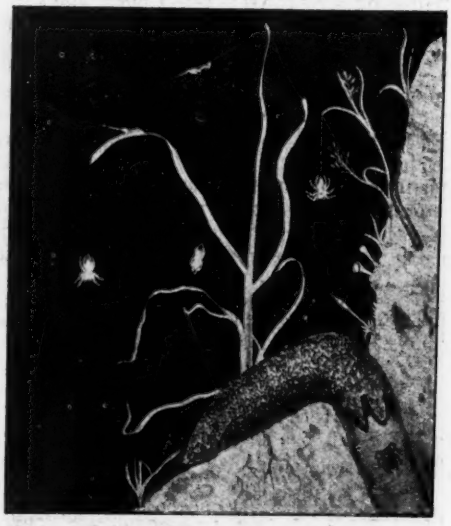


Fig. 12.—The Spiderlings departing.

then she *ate* him! carrying up and throwing out from the aërial part his tough old head, etc.! Soon after she ascended to the enlarged part of the nest (*see* Fig. 1) and there formed her wonderful hammock of eggs—the maternal instinct returning as soon as she had her family to look after.

In April the spiderlings begin to emerge. The first one ascending any grass stem, runs out to the tip of a leaf and stretches its delicate silken thread from the tube to the tip, then returns to the main stem and mounts it right to the top, from which it again pulls up tight the silken rope from the leaf; then it amuses itself by swinging and running about. Meanwhile the second spiderling has emerged, and, finding a silken ladder stretched from the hole, it ascends, continuing its upward journey until it arrives at the top. During its ascent it has also left a silken cord behind, adding strength to the first. The third does the same, and so on, until most of the family has passed out on this original ladder of silk. Some of them, however, prefer to remain nearer home, and form their tiny burrows close to their late home. (*See* Fig. 12 on the right.) So long as the spiders are swinging about,

crossing and re-crossing on their silken ladders, they are exceedingly peaceable; but directly one has made a nest of its own its true character develops, and should any of its relatives tread upon its entrance, death of the intruder is the result.

After thoroughly enjoying themselves the spiderlings ascend to the highest point, and, facing the wind, raise their bodies and spinnerets until the wind has caught the silk and blown a small quantity out (*see* Fig. 12). The spiderling, on finding itself buoyed up, severs the connecting thread and is carried away on the wings of the wind, sometimes to a great distance, where new colonies are formed.

Those of my readers who are inclined to "think upon these things" can find food for reflection in this last act of the life history of the British trap-door spider, viz., the first spiderling, after overcoming the difficulties of ascent from the nest, leaves behind it a straight silken ladder, up which the second can climb without difficulty; it in its turn adds *its* tiny thread; the third does the same—unconsciously it may be, but each one assisting its follower.

Cannot students of nature do the same, by placing on record one true fact, and so add to our knowledge of these marvellous creatures about whose life history and economy we know so little?

THE FACE OF THE SKY FOR DECEMBER.

By HERBERT SADLER, F.R.A.S.

SUNSPOTS are less frequent and are smaller in size than of late, but there are still some to be seen.

Conveniently observable minima of Algol occur at 11h. 31m. P.M. on the **5th**, at 8h. 23m. P.M. on the **8th**, at 10h. 6m. P.M. on the **28th**, and at 6h. 54m. P.M. on the **31st**.

Mercury is an evening star, but though he attains his greatest eastern elongation (20°) on the **21st**, his very great southern declination (over 25° for nearly the first half of the month) prevents any attempt at observation in these latitudes.

Venus is a morning star, but her great and increasing southern declination militates against her successful observation; she is not, moreover, a very attractive telescopic object at the present. She rises on the **1st** at 6h. A.M., with a southern declination at noon of 16° 58′, and an apparent diameter of 10½″, $\frac{95}{100}$ths of the disc being illuminated. On the **7th** she rises at 6h. 19m. A.M., with a southern declination of 18° 57′, and an apparent diameter of 10⅓″. On the **17th** she rises at 6h. 48m. A.M., with a southern declination of 21° 33′, and an apparent diameter of 10¼″. On the **24th** she rises at 7h. 7m. A.M., with a southern declination of 22° 45′, and an apparent diameter of 10⅛″. After this she is too near the Sun to be visible. During the month she describes a direct path through portions of Libra, Scorpio, and Ophiuchus into Sagittarius.

Mars is too near the Sun to be observed.

The minor planet Ceres is in opposition to the Sun on December 25th, with a stellar magnitude of 7·1. On the **1st** she rises at 5h. 22m. P.M., with a northern declination at transit of 25° 37′. On the **11th** she rises at 4h. 33m. P.M., with a northern declination of 26° 24′. On the **21st** she rises at 3h. 37m. P.M., with a northern declination of 27° 15′. On the **31st** she rises at 2h. 41m. P.M., with a northern declination of 28° 0′. During the month she describes a retrograde path in Auriga, close to the northern boundary of Gemini.

Jupiter is a morning star, but as he rises just after midnight at the end of the month we give a short ephemeris of him. On the **1st** he rises at 1h. 48m. A.M., with a southern declination at noon of 1° 18′ south, and an equatorial diameter of 31½″. On the **17th** he rises at 0h. 54m. A.M., with a southern declination of 2° 3′, and an apparent equatorial diameter of 35½″. On the **31st** he rises at 0h. 7m. A.M., with a southern declination of 2° 31′, and an apparent equatorial diameter of 36¼″. During the month he describes a direct path in Virgo, between η and γ Virginis.

Both Saturn and Uranus are, for the purposes of the ordinary observer, invisible.

Neptune is well situated for observation, rising on the **1st** at 4h. 33m. P.M., with a northern declination of 21° 47′, and an apparent diameter of 2·6″. On the **11th** he rises at 3h. 52m. P.M., with a northern declination of 21° 46′. On the **21st** he rises at 3h. 13m. P.M., with a northern declination of 21° 45′. On the **31st** he rises at 2h. 32m. P.M., with a northern declination of 21° 44′. During the month he describes a short retrograde path in Taurus, in a region rather barren of naked-eye stars.

December is a fairly favourable month for shooting stars, the chief showers being those of the Geminids on December **9th** to **12th**, the radiant point being in R.A. 7h., and north declination 32°, rising at about 4h. 10m. P.M., and setting at 1h. 40m. A.M.; and of the Andromedes on the evenings of the **26th** and **27th**, the radiant point being in 1h. 40m. R.A., and north declination 43°.

The Moon enters her first quarter at 3h. 15m. A.M. on the **1st**; is full at 4h. 54m. A.M. on the **9th**; enters her last quarter at 4h. 22m. A.M. on the **17th**; is new at 7h. 55m. P.M. on the **23rd**; and enters her first quarter at 7h. 27m. P.M. on the **30th**. The Moon will be near the Pleiades on the afternoon of the **7th**.

Chess Column.

By C. D. LOCOCK, B.A.Oxon.

Communications for this column should be addressed to C. D. LOCOCK, Burwash, Sussex, and posted on or before the 10th of each month.

Solutions of November Problems.

No. 1.

(By A. C. Challenger.)

Key-move—1. Kt to Q4.

If 1. . . . K to Q3, 2. Q to B1ch, etc.
1. . . . Kt to B3, 2. Q to Kt3ch, etc.
1. . . . Any other, 2. Kt to Kt6ch, etc.

No. 2.

(By G. J. Slater.)

1. R to B8, and mates next move.

CORRECT SOLUTIONS of both problems received from Alpha, J. T. Blakemore, and G. Coules.

Of No. 1 only, from H. H. Thomas, W. de P. Crousaz, M. Wiedhofft, Captain Forde.

Of No. 2 only, from W. Clugston, G. G. Beazley.

This problem has evidently some good tries. If 1. B to B6 (H. H. Thomas, W. de P. Crousaz, and Captain Forde), then 1. . . . B to Bsq! and there is no mate. Again, if 1. B to Q4 (M. Wiedhofft), then 1. . . . P×P. Lastly, if 1. P to Kt4 (A. H. D), 1. . . . Q to R7, and again there is no mate.

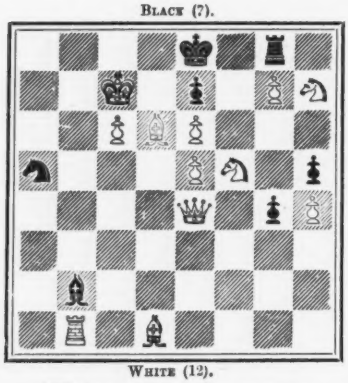
W. J. Ashdown.—Many thanks; both appear on the next page.

PROBLEMS.

By W. J. Ashdown.

No. 1.

BLACK (7).

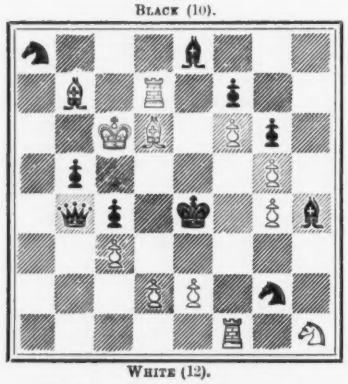


WHITE (12).

White mates in two moves.

No. 2.

BLACK (10).



WHITE (12).

White mates in two moves.

CHESS INTELLIGENCE.

The negotiations for a match between Herr Walbrodt, of Berlin, and M. Janowski, of Paris, were eventually concluded, and the match is now in progress at Berlin. Both players are relying chiefly on the Ruy Lopez, the score at present being—Walbrodt, 2; Janowski, 3; drawn, 2.

After a delay of several months the Championship of the Southern Counties Union was decided on October 6th by the retirement of Somerset, who were unable to raise a team against Surrey. Surrey accordingly are again declared the champion county.

A match of ninety-three players a side between East and West Sussex resulted in a win for the former by the narrow majority of two games; thus exactly reversing the result of last year's encounter.

A handicap tournament at the City of London Club, played at the rate of one hundred and twenty moves an hour, resulted in a division of the prizes between Messrs. Herbert Jacobs, C. J. Woon, and Harold Jacobs.

The obituary among chess players this autumn is unusually large. M. L. Febvret, a well-known frequenter of Simpson's Divan, and a competitor in the Minor London Tournament of 1883, has died at the age of seventy-two years.

Mr. N. W. van Lennep, the Dutch master, who was reserve man in the Hastings International Tournament and has since been living in London, died on September 27th. He was one of the strongest players in England.

Herr Berthold Englisch, a competitor in the recent Berlin Tournament, who retired owing to ill health, died shortly afterwards at Vienna from paralysis of the brain. Herr Englisch was the founder of the Vienna school of so-called "drawing masters," of which Herr Schlechter is now the leading exponent. His best performance, perhaps, was in the London Tournament of 1883, when he tied for fifth prize with Captain Mackenzie and Mr. Mason, then at their best. The prize winners above him were Zukertort, Steinitz, Blackburne, and Tchigorin. Herr Englisch was the most rapid tournament player we have ever seen. In his games with Herr Zukertort, the winner of the 1883 tournament, his average speed was considerably over thirty moves an hour, the authorized time limit being fifteen. His tendency was always in the direction of simplification and concentration on any weak point. If the weak point was defensible after the simplification the game would naturally be drawn. This accounts for the large proportion of Herr Englisch's drawn games. In some cases he was a little too ready to accept a draw in order to secure a day's rest, especially when his opponent was a player of his own school; but no man can be blamed for consulting his own health and temperament in a contest involving such a prolonged mental and physical strain. The penalty lies in the fact that the man who spares himself cannot attain to the highest honours. Last year Herr Englisch played a match with Pillsbury, in which every game resulted in a draw.

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PLATE.—The Moon.

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